MACKENZIE VALLEY PIPELINE INQUIRY

IN THE MATTER OF AN APPLICATION BY CANADIAN ARCTIC GAS PIPELINE LIMITED FOR A RIGHT-OF-WAY THAT MIGHT BE GRANTED ACROSS CROWN LANDS WITHIN THE YUKON TERRITORY AND THE NORTHWEST TERRITORIES FOR THE PURPOSE OF THE PROPOSED MACKENZIE VALLEY PIPELINE

and

IN THE MATTER OF THE SOCIAL, ENVIRONMENTAL AND ECONOMIC IMPACT REGIONALLY OF THE CONSTRUCTION, OPERATION AND SUBSEQUENT ABANDONMENT OF THE ABOVE PROPOSED PIPELINE

(Before the Honourable Mr. Justice Berger, Commissioner)

Yellowknife, N.W.T.

May 16, 1975.

PROCEEDINGS AT INQUIRY

VOLUME 40

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APPEARANCES:

Mr. Ian G. Scott, Q.C. Mr. Stephen T. Goudge, Mr. Alick Ryder and Mr. Ian Roland	for Mackenzie Valley Pipeline Inquiry;
Mr. Pierre Genest, Q.C. Mr. Jack Marshall, Mr. Darryl Carter, and Mr. John Steeves	for Canadian Arctic Gas Pipeline Limited;
Mr. Reginald Gibbs, Q.C. Mr. Alan Hollingworth	for Foothills Pipelines Ltd.;
Mr. Russell Anthony, Prof. Alastair Lucas	for Canadian Arctic Resources Committee;
Mr. Glen W. Bell and Mr. Gerry Sutton	for Northwest Territories Indian Brotherhood and Metis Association of the Northwest Territories;
Mr. John U. Bayly	for Inuit Tapirisat of Canada and the Committee for Original Peoples' Entitlement;
Mr. Ron Veale and Mr. Allen Lueck	for Yukon Native Brotherhood;
Mr. Carson H. Templeton	for Environment Protection Board;
Mr. David Reesor	for Northwest Territories Association of Municipalities
Mr. Murray Sigler	for Northwest Territories Chamber of Commerce

I N D E X

Yellowknife, N.W.T.
May 16, 1975

(PROCEEDINGS RESUMED PURSUANT TO ADJOURNMENT)

MR. MARSHALL: Mr. Commissioner, we're ready to begin this morning with the operations and maintenance panel. The members are Mr. Hurd, Mr. Fielder and Mr. Carlson. Perhaps Miss Hutchinson should swear them.

DONALD ERNEST FIELDER,
LEE GORDON HURD,
MELVIN E. CARLSON, sworn:

DIRECT EXAMINATION BY MR. MARSHALL:

Q Mr. Commissioner, I'd like to proceed with the qualifications of the witnesses, starting with Mr. Lee Gordon Hurd, who is in the centre and is the chairman of the panel.

Mr. Hurd, your present position is that of Director of Planning and Special Studies for Canadian Arctic Gas?

WITNESS HURD: That is correct.

Q Your educational background is you have a degree from the University of Alberta, a Bachelor of Science in Chemical Engineering which you obtained in 1952.

A Yes.

Q Your professional affiliations, sir, are with the Association of Professional Engineers in Alberta; also you are a member of the British Columbia Association and the Yukon Territories Association of Professional Engineers.

A That's correct, yes.

Q Could you outline briefly, sir, your professional experience beginning in 1952?

A Beginning in '52, Mr. Marshall, I was employed by a natural gas company operating in Central Alberta. The company owned and operated several gas wells and processing plants, and about 70 miles of gathering and transmission pipelines.

For three of the five years I was manager of the company, responsible for its ongoing construction programs and its operations.

Q And then, sir, from 1957 through '59?

A During that time I/was senior design engineer with Westcoast Transmission Company Limited in British Columbia. That company at that time owned and operated about 1,000 miles of gathering transmission pipelines, including compressor stations and a processing plant. My responsibilities included the design of facility additions, construction management, and assisting with the development and implementation of the company's operating practices.

Q Then from 1960 to 1961, sir, you were a project engineer for Canadian Bechtel Limited?

A Yes.

Q What responsibilities did you have at that time, sir?

A My responsibilities were

the design of the Alberta Gas Trunkline, Foothills Division, pipeline.

Q From 1962 to 1970, sir, you were employed by Alberta & Southern Gas Company Limited and Alberta Natural Gas?

A Yes, that's right.

Q What responsibilities did you have with those organizations, sir?

A I was responsible for the gas operations of Alberta & Southern, and in this capacity I worked very closely with the Operations Department of Alberta & Southern, and with Pacific Gas Transmission Company. I was also responsible for the design of facilities expansions on the Alberta Natural Gas system, and I held several positions with these companies ending with vice-president of Planning and Development.

Q And from 1970 to the present, sir, what positions have you held?

A I've been employed by Canadian Arctic Gas Study Limited, and one of the predecessor groups for that company, the Northwest Projects Group, for which I was the project manager. During this time I have been responsible for a variety of studies including overall project co-ordinating functions and preparing and co-ordinating the exhibit materials.

Q Thank you, Mr. Hurd.

Next, Mr. Donald E. Fielder. Mr. Fielder, your present position is that of manager

of operations and maintenance, Canadian Arctic Gas?

WITNESS FIELDER: That's correct, Mr. Marshall.

Q And your university background is that you have a degree from the University of Oklahoma obtained in 1957, Bachelor of Science in Mechanical Engineering.

A Correct.

Q You're a member of the Professional Association of Engineers, Geologists and Geophysicists of Alberta.

A Yes sir.

Q You are also a member of the Rules & By-Laws Committee of A.P.E.G.G.A.

A Yes sir, that's the Association of Professional Engineers.

Q I see, and you are a member of the C.S.A. Standard Z-184 Code Committee.

A That was correct four days ago, sir. I am an ex-member of that Code Committee now, but still a member of the Transmission & Northern Sub-Committees mentioned below.

Q I'd like you to review briefly your professional experience, sir, beginning in 1957. You were with Robinson Machine & Supply Company Limited in Calgary.

A Yes sir.

Q What responsibilities did you have there, sir?

A Yes, sir, I was responsible for the design, construction and operation of company owned pipelines and stations and in that respect directed the activities of an engineering department in the areas of economic evaluation of pipeline systems, selection of pipeline routes, electrical, mechanical and civil, material selection, writing of contract specifications, contractor selection, material expediting and the co-ordination and supervision of construction activities until project completion and in addition was responsible for operational engineering problems.

Q Sir, in 1965 and to 1971 you were with the Peace Pipeline Company Limited in Calgary?

A Yes, sir.

Q And as assistant chief engineer?

A Yes, sir.

Q Would you summarize briefly your responsibilities in that position, sir.

A I was responsible for the supervision of company and consulting engineering personnel for general pipeline and station engineering construction operation, for the preparation and specification and selection of computer based supervisory and data acquisition systems, for the design and construction of several remotely and locally controlled stations, for the co-ordination and

installation of the communication system, and for a period of time served as field superintendent and also as chief dispatcher.

Q And from 1971 to the present, sir, you have been associated with this project and its predessors?

A That is correct, Mr. Marshall.

Q What positions have you held, sir?

A I began with Gas Arctic Systems as a supervising engineer and subsequently with Canadian Arctic Gas Study Limited during which time I became manager of pipeline design and at the beginning of 1975 became manager of operation and maintenance.

Q What have your responsibilities included with the project, sir?

A Since 1971 I have had for Gas Arctic Systems and Canadian Arctic Gas Study Limited, responsibility for the development, implementation and monitoring of progress of various design, study and basic research programs carried out by consulting engineering personnel.

Emphasis in terms of both funds and effort expended has been in the field of geotechnical research activities relating to pipeline rights-of-way and station sites in permafrost terrain.

I was also responsible for supervision of operation of the Arctic Permafrost Research Test Facilities at

both Prudhoe Bay, Alaska and Norman Wells, Northwest Territories, for the collection of data and the development of plant operation and maintenance programs. I was responsible for the approval and progress monitoring of programs developed for analysis of Arctic test facility data; data collection and analysis included the impact of various construction techniques, design configurations, fluid temperatures and that sort of thing on permafrost terrain. The data collected therefore included meteorological, geothermal and geotechnical, the analysis however was carried out be assigned research scientists and consulting engineers.

I have also been responsible for project guidance with research scientists in the development of a pipeline project oriented geothermal analysis computer program for the establishment of the scope of thermal analysis studies required and for the review analysis reports submitted by geothermal analysis consulting personnel and currently as manager of operation and maintenance it is my responsibility along with Mr. Carlson to help set up the organization which will be charged with the operation of the Arctic Gas system.

Q Thank you, Mr. Fielder, now, Mr. Melvin E. Carlson, you are the Director of Operations and Maintenance for Canadian Arctic Gas?

WITNESS CARLSON:

A That is correct.

Q And you have a degree from the University of Alberta, Bachelor of Science in Electrical Engineering?

A Yes, sir.

Q And you are a member of the Engineering Institute of Canada and the Association of Professional Engineers for Ontario and Manitoba?

A that is right.

Q Sir, your professional experience, if I may summarize it, beginning in 1952, and '53 you were with Perforating Guns of Canada Limited, Edmonton?

A Yes, sir.

Q Is that correct, and from 1953 to '56 were with Imperial Oil Limited in the Edmonton and Toronto offices working as an engineer?

A That is correct.

Q From 1956 through to 1975 you have held a variety of positions with Trans Canada Pipelines Limited, is that correct?

A That is correct, sir.

Q Beginning in 1956 and through '58 as an office engineer, beginning in '58 through '60 as a senior engineer, from 1963 to 1964 as the senior engineer for construction services?

A That is right.

Q 1964 through '68 a senior engineer in pipeline design?

A That is right.

Q 1968 to 1971 supervising engineer of pipeline design. 1971 to '72 assistant chief engineer pipeline division and operations?

A That's right.

Q 1972 to '74, the manager of facilities operations. Perhaps, sir, at this point you could elaborate somewhat on your duties in that position as manager of facilities operation .

A My duties and responsibilities in that position included the managing of the technical support staff devoted entirely to the field operation of the T.C.P.L., compressor station and pipeline facilities. These responsibilities included the following operations: The compressor section, communications and control section, performance analysis section, pipeline section, gas measurement, corrosion and the Trans-Canada test facility.

Q Yes sir, then from 1974 to just recently you were the manager of operations for Trans-Canada?

A That's correct.

Q What were your duties and responsibilities in that position, sir?

A My additional duties included all facets of construction supervision, commissioning and start-up of new facilities, field operation and maintenance of the T.C.P.L. transmission system.

MR. MARSHALL:

Thank you, Mr. Carlson. Sir, I'll file copies of the resumes for each of the witnesses with Miss Hutchinson, as well I'd like to file a list of the reports and studies upon which they rely, or to which they may refer.

(OPERATIONS & MAINTENANCE PANEL WITNESSES RESUMES MARKED EXHIBIT 122)

(LIST OF REPORTS & STUDIES ON WHICH O. & M. PANEL RELIES MARKED EXHIBIT 123)

MR. MARSHALL: Q Sir, as you're aware, Mr. Fielder was the representative of Arctic Gas who visited the Soviet Union and you had expressed interest in hearing of his trip. As Mr. Fielder is a member of the panel I thought it might be appropriate to have him deal with that first, and I'd like to proceed with that now before turning to the operations and maintenance testimony itself.

Mr. Fielder, have you had any recent exposure to Soviet pipeline design, construction and operating techniques with special emphasis on Arctic and permafrost problems?

WITNESS FIELDER: Yes sir. During the period from November 19 through December 2, 1974, I,accompanied by several other Canadians with varied interests, but generally pertaining to the gas industry , visited the Soviet Union. The visit was organized and sponsored by the Federal Department of Industry, Trade & Commerce, and formed part of the Canadian contribution to an organized exchange of technology relating to the gas industry.

You might also be interested to learn that during a subsequent and reciprocal visit I acted as host to a group of Soviet experts in Calgary on Friday, March 21 of 1975. During that meeting a member of Dr. Clark's staff described to the

Soviets the status of our research in the field of frost heave, and we all answered many questions they posed mostly related to foundation design in ice-rich permafrost .

During my visit to Russia, meetings were held with various senior members of the U.S.S.R. Gas Ministry and other associated Ministries in Moscow, in Donetsk in the Ukraine -- that's spelled D-O-N-E-T-S-K -- in Tuymen and Nadym in Western and Northwestern Siberia. Tuymen is spelled T-U-Y-M-E-N and Nadym, N-A-D-Y-M.

The purpose of the questions posed by we Canadians was to determine the manner in which the Soviets deal with problems relating to the development of gas fields, i.e. the drilling, the construction and operation of gas gathering systems, and treatment plants, and the design, construction and operation of gas pipelines and compressor stations, all in areas of permafrost.

Q Why were you selected to participate in this visit?

A At the time the selection of Canadian delegates was made, I was manager of the Pipeline Design Section of Arctic Gas. I was both interested and had an obvious need to learn as much as was possible respecting Soviet permafrost engineering as it applies to the design, construction and operation of gas pipelines.

Q Would you tell us briefly what you learned, Mr. Fielder?

A Unfortunately, not a great deal. We were all very disappointed to learn after our arrival in Moscow that while the area we were to visit in the Soviet Arctic is described as an area of discontinuous permafrost, that most of the pipeline and all of the above ground facilities had been located deliberately in areas which contained little or no permafrost. The area I refer to is the southern portion of the Medverzhye gas field, and that's spelled M-E-D-V-E-R-Z-H-Y-E, that's the Medverzhye gas field which is located in Northwestern Siberia approximately 1,200 km. or 746 miles north of the City of Tuymen, which is located in the Province of Tuymen. It's also approximately 50 km. or 31 miles from the Arctic Ocean. The pipelines serving that area run generally south-west from the Medverzhye area to serve markets in the Urals and in Moscow, and they utilize both buried and grade or bermed construction techniques.

Q How was it possible for the Soviets to avoid permafrost terrain problems when locating their pipelines and above-ground facilities in an area of discontinuous permafrost?

A Avoidance of permafrost areas along the pipeline route was accomplished by locating all of the facilities as much as was possible in river floodplains which do not contain permafrost. Between the river valleys the pipelines were located along relatively high ridges of well-drained permafrost. The area is predominantly sand which was, we are told, easily trenched and caused very few problems.

The area that we saw was very old. Never, we were told, having been glaciated. The river valleys were very wide up to about 13 kilometers or about 8 miles with the wetted banks being only three to four meters or ten to thirteen feet in height. Secondary banks had very gentle slopes and the relief in the area appeared from the air to be less than 30 meters or about 98 feet.

As I mentioned earlier the soil was mostlysand and was well drained in the higher areas. Now, problems with the permafrost there were so minimal that the gas pipelines are operated at a temperature range of plus 3 to plus 40 Celsius which is 37 to 104 degrees fahrenheit. --As you can see, well above the melting temperature of ice.

Q Did you discover anything relevent during your visits to design or research center in the Soviet Union?

A I visited both

design and research institutes in Moscow, Donetsk and in the City of Tuymen. It is very difficult to evaluate the usefulness of what we were told during our several visits. Firstly, with respect to design, we were shown, just for example, the manner in which burried and grade construction techniques are designed for permafrost areas, but were not able to see those designs either being constructed or to be able to evaluate any operational problems which might have occurred as a result; we were told, however, that berms often had to be re-built annually and indeed we saw some of that work going on .

As far as research is concerned, we were told that a great deal of basic permafrost research is, and has been carried out but saw little evidence of the implementation of that research. I do not mean to imply that Soviet research programs are never translated into designs and construction techniques, because if this were the case they would not have been able to carry out the very extensive development that they have of their northern resources. Obviously, a great deal of useful work has been done. Some of the members of Dr. Clark's panel, as was previously mentioned, attended the 2nd International Conference on Permafrost which was held in Yakutsk in June of 1973, and speak very highly of the amount and type of research which was carried out in the Soviet Union.

Q Are there other areas in the Soviet Union in which pipelines have been installed in Arctic areas containing permafrost which

could be more useful from an educational point of view?

A There are two other pipelines which are located in the permafrost in the Soviet Union. ONe runs between Norilsk and Messoyakha and Norilsk is spelled N.O.R.I.L.S.K. and Messoyakha is spelled M.E.S.S.O.Y.A.K.H.A. It runs between Norilsk and Messoyakha and is constructed above ground on piles. The other is in the Yakutsk area and is partly on piles and partly buried. Two earlier Canadian delegations visited the Norilsk-Messoyakha line and perusal of their reports did not add a great deal to our knowledge of permafrost pipeline techniques. The primary purpose of one of the groups was to note the environmental after effects and according to the report they noted very little lasting environmental damage.

ANother clue that strengthens my impression that we will not likely learn a great deal more from additional visits to Russia, is that I discovered in my visits that the Soviets had not constructed any test sites prior to starting designs and construction and apparently now feel that test sites are required. I was questiones at length about what we had learned from our Arctic gas sites, how they were laid out, pipe sizes, fluid temperatures tested and measuring equipment utilized and that sort of thing. I was also asked to approve the training of a Soviet engineer or research scientist for a period of

45 days at the Sans Sault Test Site. During the course of these discussions I learned that the Soviets now plan to construct two pipeline and several gas well test sites in the Medverzhye area of Siberia.

During my meeting with the Soviet delegation in CAlgary on March 21, I was able to confirm that the three systems that I described earlier are the only ones installed installed in the Soviet Union in permafrost and that no pipelines have been buried there in ice rich permafrost. IN anticipation of having to do so they asked us many questions relating to our plans for foundation designs for heavy rotating machinery in areas containing ice-rich permafrost.

Incidentally, you should know that access to the areas I've described in the Soviet Union is very difficult and is normally considered out of bounds to westerners. Access is only available as a result of the Canada-U.S.S.R. Industrial Exchange Agreement on Science and Technology, which was organized by the Federal Department of Industry, Trade & Commerce. Part of that agreement provides for the sort of trips I have just described.

Q In what manner do you think Arctic Gas and other interested Canadian groups can best keep abreast of and make use of the permafrost research carried out by the Soviets?

A By keeping abreast of developments as described in the literature. The National Research Council of Canada publishes translations of such papers, and these are available at little cost.

MR. MARSHALL:
Thank you, Mr. Fielder. Mr. Scott suggested that perhaps we just proceed with the O. & M. panel, sir, without having Mr. Fielder cross-examined separately at this time, if that meets with your approval I think we will just carry on.

MR. SCOTT: I raised at an earlier stage with Mr. Genest, I'm not sure whether it was formally at the hearing or informally, the question of providing to us a copy of Mr. Fielder's report to the Department of Industry, Trade & Commerce

and the question of producing for us, with the co-operation of the government, the joint report of all participants on this trip which was compiled by the Department. I wonder if Mr. Marshall is able to tell us whether either of those things are possible, and what they have done about it. I understand he hasn't gotten them yet.

MR. MARSHALL: I believe the reports have been listed in the index and have been available in the library upstairs for some weeks. But I shall check that, Mr. Scott.

MR. SCOTT: Thank you.

THE COMMISSIONER: Well, before you proceed with the other members of the panel, let me just ask Mr. Fielder a few questions.

Q These three pipeline systems, Mr. Fielder, how long are they? What is the length of each pipeline system, do you know?

A Not in detail, sir. I don't have any information on the pipeline in the Yakutsk area at all. As far as I know, no reports are available, I haven't seen any. The Messoyakha-Norilsk pipeline, I think I can answer that very quickly here -- sir, I don't have the length of that. It's buried in this report somewhere, I can dig it out for you. One thing I could mention to you is that when they built it on piles, being concerned about the effects of temperature on the pipeline that was exposed and also in an attempt to avoid permafrost as much as possible, the line snaked around enough

that it increased its length by approximately 13% over the straight line distance that could have been taken, had they decided to do so.

Q Do you know what the diameter of the pipeline was?

A The Messoyakha-Norilsk Pipelines, two of them now, and they're both 72 centimeters or 28-inch, the lines that run from the Medverzhye field down through a place called Punga and eventually on into the Soviet grid system was 48-inch, the initial diameter was 48-inch. It's since been partially looped at least once, and partially looped twice in places with 56-inch. I don't know the length of those lines either, sir, because the map we were given is written in Russian and as they use a different alphabet than us, it makes it very difficult to sort the thing out. But it's hundreds of miles.

Q Thank you. In the Soviet Union, as I understand it, the industrialized part of the country is in the west, in the sense that the industrialized part of our country is in the south, putting it very roughly.

A I think that's correct.

Q Are they transporting that gas merely to local centres in the vicinity of the Arctic Circle, comparable say to Yellowknife or Whitehorse, or even to Inuvik or smaller places than Yellowknife and Whitehorse, or did you say that they're tying it into some -- into their whole natural gas

grid so that the gas winds up in the industrialized sector of the Soviet Union?

A The latter, sir. The connection to the Soviet grid system has certainly been made. I am not certain that gas from the North-western Arctic or Northwestern Siberia actually ends up at some of the industrial locations because in addition to their own uses they are exporting a great amount of natural gas to other countries in Europe, and it may well be that it goes there. But certainly it's tied in with the system.

Q You said that you were advised when you were there that -- you indicated that the conditions in which you found these pipelines were such that there wasn't a great deal that you could learn from the Soviet experience. You said they wanted to set up test facilities because they were going to undertake building pipelines in conditions similar to those of the Arctic Gas proposal here. Is that essentially what you meant?

A Yes sir. They were anticipating, as they expanded the Medverzhye field into the northern end of the field they would run into ice-rich permafrost and hence were concerned about what might happen when they install the warm gas pipelines that they seem to prefer, for reasons I don't understand.

Q We were told that one of the likely results of detente would be -- I shouldn't say "one of the likely results" but I think

you will recollect that it was suggested that one of the possible results of detente might be to export natural gas from Siberia to the mainland, the lower 48 in North America. Was there -- were these new lines that were being discussed connected in any way with that proposal, or was that simply a proposal that no one indicated to you was being pursued?

A I know from a separate source that the proposal you mentioned is still being considered. But I understand that the gas location is somewhere in what I'd call Southeastern Siberia off to the East Coast somewhere north of Japan, and these are in areas of non-permafrost. As I understand it would be a liquification sort of a scheme. It had nothing to do with our trip, and many, many thousands of miles away.

Q And it wouldn't be brought -- it would be brought by -- liquified and brought by tanker then, presumably, if it were done.

A That's what I understand, sir, yes.

Q Well, thank you very much, Mr. Fielder. I wonder if you, since I think you will be obliged to return on Tuesday, if you wouldn't mind over the weekend, just as a favor to the rest of us, to draw a rough map -- I mean by hand, don't go to any trouble -- of the location of these gas lines in the Soviet Union so that we might have some idea of where the Medverzhye field is and so on and so

forth if you don't mind?

A I'd be pleased to do so.

THE COMMISSIONER: Well, carry on, Mr. Marshall.

MR. MARSHALL: Thank you, sir.

Q Mr. Hurd, I understand that the substance of the testimony of your panel is contained in Section 13 B filed with the Inquiry as Exhibit 55, and in certain responses to the Pipeline Application Assessment Group questions which were also filed, specifically the question numbers were 22, 54 and 55. Sir, would you highlight for us, please, the O.& M. plans described in those documents?

WITNESS HURD:

A Yes, Mr. Marshall. First of all by way of introduction to Section 13 B, that you referred to.

THE COMMISSIONER: Excuse me, forgive me, Mr. Hurd, are there canned notes on this?

MR. MARSHALL: Sir, we have distributed really what amounts to, I guess, a one page statement saying that,essentially he will just highlight it.

THE COMMISSIONER: All right.

MR. MARSHALL: Mr. Hurd has prepared from that a kind of a condensation of the materials in 13 B, being the points that he wants to highlight. We have not made copies of that. It is partly typed and partly on handwritten notes. It is really a condensation of materials that are there and you can follow really section 13 B, exhibit 55 -- Mr. Hurd will simply highlight that.

THE COMMISSIONER: All right, that is all that I wanted to know.

All right, 13 B.

MR. MARSHALL: Sir, if it will assist you, Mr. Fielder has a copy of it that he said you could follow along.

THE COMMISSIONER: Thank you.

MR. MARSHALL: Mr. Hurd?

A Thanks, Mr. Marshall. By way of introduction to section 13 B which you referred to, that section sets forth the principles and the considerations which have guided our planning to date for the operation and maintenance of the proposed pipeline. In addition the present plans are described in order to allow a general evaluation of the likely manner and the effect of the operation of the pipeline.

Such plans have been based of course on our best present view of the facilities and the conditions which will likely be involved in the pipeline operations and of Government's and industry's standards. As detail design and on the ground surveys progress futher and as construction is completed and as operations begin thereafter it will be necessary from time to time to make some modifications in the principles. As the operational stage approaches, a detailed operations and maintenance procedures manual will be developed and issued for reference and observance by operating personnel.

The operations and maintenance planning has as a basic component the fact that the compressor stations are designed and will be constructed to remote-- to operate by remote control. Accordingly the O. & M. personnel and their permanent living accomodations will be concentrated at the operating bases with provision being made for living accomodation

at the compressor station sites for personnel who are required to be there for longer than one day. Compressor stations will be monitored and controlled by the gas control centre. The remote control function commands will adjust station set points and start or stop compressor units to maintain the required throughput of the pipeline. Compressor stations in regions of permafrost will include a propane refrigeration system that will control station discharge gas temperatures.

Mr. Marshall, the next section -- the next sub-section in Section 13 B is a glossary of terms and I propose that we do not spend any of that -- any time on that. I think those terms will become clear as we proceed through the balance of the testimony.

MR. MARSHALL: Fine, Mr. HUrd.

A To continue then with the -- and firstly with the operating and maintenance organization. For purposes of operation and administration, the pipeline has been divided into operating units described as divisions and districts. Within the divisions and districts manpower and equipment will be provided for the maintenance and operation of the pipeline. District work crews will maintain and operate the pipeline within their districts and be prepared to handle contingencies. The numbers and locations of personnel assigned to the various divisions and districts -- a general description of the equipment to be provided

for the districts and the divisions and the relationships of the operating and maintenance division and district organizations to the operations headquarters organization will be described in detail by Mr. Fielder who will use the projecting equipment there to show the tables and charts which follow Section 13 B. These will be shown just a little later.

MR. HOLLINGWORTH: Excuse me a moment, Mr. Hurd. I wonder if the reporter could turn up your microphone a bit, as I am having a little difficulty in hearing.

A Is that a little better?

MR. HOLLINGWORTH: That is better, fine.

A In recognition of the fact that the pipeline will form part of a total system to transport not only Canadian Gas but also gas from Prudhoe Bay Alaska, co-ordination with Alaskan Arctic Gas Pipeline Company will be accomplished through the applicant's operations headquarters and / gas control centre. The tables which Mr. Fielder will show indicate the current estimates of the number and locations of personnel required to operate and maintain the pipeline during each of the first five years of its operation. These figures anticipate that the build up of the facilities to a capacity of 4.5 billion cubic feet per day in the fifth year of operation. The figures given for the third through the fifth year

of operation have been prepared on the same basis as the first two years and do not reflect the possibility of changes in such requirement resulting from the multi-discipline performance of personnel, changes in technology and experience gained in operations during the first years of operations.

The applicant plans to hire northern residents to fill its full time personnel requirements to the greatest extent possible. Important influences on these plans will be the success of recruitment and training programs designed to attract local residents, the productivity and turn over of personnel, the availability of contractor and suppliers personnel and the length of time required for individuals to become skilled in more than one basic technical discipline.

The estimated personnel requirements anticipate the achievement of pipeline industry standards of expertise and productivity by all of the applicant's employees. Specific work schedules for the applicant's employees will be based from time to time on the varying needs of the pipeline and on the relevant sociological and environmental considerations.

With the compressor stations and other sites being designed for remote operation employees involved in preventative maintenance and routine inspection programs will move between such locations on a planned basis.

They may be required to return -- they may return to their operating base after a day's work, or maybe required to be away for several days at a time. The personnel requirement tables include sufficient manpower to permit two technical maintenance personnel to be present at each compressor station at all times during such period of time, after startup, as the applicant considers necessary to do regular maintenance work and to be available to analyze and remedy minor operating upsets.

The basic pattern is expected to be for employees to be permanently resident at the general location of their operating bases, with living accommodations at the compressor stations for any on-duty personnel required to stay overnight.

In addition to the recruiting of full-time personnel, we contemplate the part-time hiring of personnel from communities within the districts. In these cases the applicant would make any necessary arrangements to ensure that these personnel are transported to and from its operating bases, and are provided with any necessary living accommodation during the periods of such employment. It is expected that this part-time work will be part of the applicant's local hiring policy, providing a source of personnel who, where competent, will decide that they wish to fill vacancies in the applicant's full-time organization and who will have an opportunity to become qualified to do so through participating in

the applicant's training programs and by on-the-job experience.

Certain equipment and materials will be required by the operating pipeline company. I'd like to describe first the ground transportation and work equipment. The tables which Mr. Fielder will show a little later indicate our tentative selection and locations for major items of ground transportation and work equipment. This selection was made on the basis of the specifications of equipment currently available. In the ultimate selection of equipment the applicant will take full advantage of improvements in design and continuing observations and evaluations of equipment employed on the construction of the pipeline.

On the basis of our present knowledge, we can describe firstly certain of the conventional equipment which will be required. Where the pipeline is accessible from all-weather roads, the transportation of operations and maintenance personnel and materials will be by conventional wheeled vehicles. Heavy equipment will be taken to point of use by trailer haul units. The types of conventional equipment to be employed will include firstly, personnel carriers, which will consist of light trucks with 4-wheel drive providing capability for occasional travel along the right-of-way and a small complement of tracked personnel carriers for use in adverse winter snow conditions.

Secondly, work equipment, for

use in scheduled routine maintenance activities at compressor stations, meter stations, block valve locations and along the right-of-way. Types of work equipment are: Flat-deck winch trucks for general hauling of replacement parts, consumable supplies, etc. Flat-deck trucks with hydraulic cranes for loading and hauling. Dump trucks for hauling bulk materials. Wheel-type graders for road maintenance and snow ploughing. Wheeled-type tractors with front-end loader and backhoe attachments, and welding rig trucks.

Thirdly, heavy equipment which is used in major repair operations and includes side boom tractors for handling pipe and other heavy items, bulldozers for earth-moving operations, and track-mounted backhoes and draglines.

Lastly, transport equipment which is used for the road hauling of heavy equipment, pipe, valve assemblies, bulk liquids, etc. These are truck type tractor units with trailers.

Besides the conventional equipment, certain special equipment will be required to meet the conditions which are introduced by the lack of an access road network, the sensitivity of terrain and the extremes of climate. Although the applicant proposes to make use of aircraft for the transport of manpower and light equipment required in scheduled maintenance activities, there will be a requirement for surface transportation of heavy equipment for any major repair activity. The types of special equipment to be used will include personnel

vehicles, which will most often be light-weight tracked vehicles with enclosed cabs to accommodate work crews, and transport equipment which will be special equipment designed to produce a low ground pressure by distributing its weight load over a large area of contact with the ground, and will be used for surface transport of heavy equipment and materials where required to protect sensitive terrain.

Three main types of low ground pressure equipment will be employed. Firstly, track equipment providing low ground pressure in a variety of configurations and load ratings Secondly, balloon-tired equipment similarly providing low ground pressures.

And finally, snow sleds employing large area runners to distribute the weight of heavy loads for hauls over winter snow and which can be towed.

Low pressure transport units having load capacities in excess of 40 tons and fully loaded ground pressures of 4 pounds per square inch are currently available for commercial sources, and have been successfully used in the north. We plan to equip some low ground pressure units with attachments to permit their use in excavation operations.

In addition, special purpose equipment will be provided at different locations. This special purpose equipment will include terrain protection mats consisting of light-weight sections capable of distributing heavy loads over their whole area and which can be transported by air to a site -- a

repair site for assembly into a work area on which equipment can be moved and operated with a minimum disturbance to the underlying terrain; and pontoon sets consisting of air transportable float and deck modules which can be assembled to provide temporary bridges over water crossings and an air-cushioned vehicle which we intend to have based at Inuvik to transport equipment and materials across water bodies during flooding.

Mr. Fielder will describe the special equipment I've referred to, using the projector a little later.

The need to use this equipment for right-of-way maintenance activity is expected to diminish significantly with the passage of time from startup. For example, heavy equipment for earth movement should be required in the right-of-way only after unusual developments such as an extremely heavy downpour which may have been so violent as to cause soil erosion at some point on the line. The need for major repairs to the line is expected to be so infrequent as not to be statistically noteworthy in estimating the frequencies of the movement of heavy equipment on the right-of-way.

Crossings of unfrozen rivers on the right-of-way will be made by amphibious equipment and bridges. After freezeup, snow roads and ice bridges can be developed, if necessary, for equipment used to transport required heavy machinery, fuel, gravel, and other supplies. In the sensitive

terrain areas, use of the right-of-way for maintenance purposes will be largely by low ground pressure vehicles and will also be limited wherever possible to periods when the right-of-way is frozen. For maintenance which must be done at other times, aircraft will be the preferred method of transporting workmen and light equipment to the work sites.

Now I'd like to elaborate a little bit on air transportation. Our plan for the operation and maintenance of the pipeline contemplates the use of both fixed wing aircraft and helicopters for line patrol, and for the transport of personnel and materials from operating bases to compressor stations and other sites. The following are five types of aircraft which we presently consider will be used in our operations:

Type A is a fixed wing aircraft having a short takeof and landing characteristics, a variable passenger/cargo capability of up to 18 to 20 passengers, or a 4,000 pound load. Its principle function will be the transportation of materials and personnel from the operating bases to air strips in the vicinity of locations of maintenance activity.

Type B is a small fixed wing aircraft having a capacity for three passengers. Its specific function will be line patrol.

Type C is a large fixed wing cargo aircraft with a freight capacity of 45,000 pounds. Its principal function will be the infrequent scheduled re-supply of bulk materials, the emergency transportation of

machinery components and work equipment to major air strips in areas in which the pipeline is not accessible from all-weather road systems. This aircraft will be chartered when its use is required.

Type D is a passenger helicopter having a capacity for four passengers and a sling load capacity of approximately 1,200 pounds. Its principal function will be the transport of personnel, tools and supplies required in the maintenance of pipeline right-of-way and other sites. It will be owned by the applicant.

Type E is a cargo helicopter having a sling load capacity of 8,000 pounds, or in passenger configuration, a capacity for 26 passengers. Its principal use will be the transport of personnel, tools, equipment and supplies for operations and maintenance activities requiring capabilities beyond those of the Type D helicopter. One based in Inuvik will be owned by the applicant and used mainly in the northern section of the Northern Division. Occasional leasing of one in each of the Norman Wells and Fort Simpson Districts will be necessary from time to time.

All aircraft will be equipped to meet the requirements of the Ministry of Transport for operation under instrument flight rules. Air crews will be responsible to the relevant district superintendent for flight programming and supervision. For fixed wing aircraft we will have well-equipped aircraft landing strips at most compressor stations where such stations are not adjacent to all-weather roads. The helicopter offers a convenience that its

loads can be placed anywhere along the right-of-way without the need of long air strips.

All flights of the applicant's aircraft will be authorized only by senior district supervisory staff, who will schedule all routine maintenance work at the remote sites, and aircraft line patrols in such a manner that flights will be kept to a minimum. Such senior personnel would consult current data on wildlife conditions in the general area of the required flight in order to assist in the selection of a suitable type of aircraft and a flight path and altitude which will minimize the affects on wildlife.

At this time it is difficult to provide an accurate estimate of the number of air patrols and maintenance flights which the applicant will require for its operation and maintenance purposes. We estimate that maintenance flights should normally require approximately one to three flights a week to each air strip. Line patrols will vary according to the season and terrain in the area of the line. Most sections of the right-of-way can normally be patrolled once or twice monthly. Other sections passing through terrain having a high frequency of cross-drainage or with slopes subject to excessive run-off will be patrolled more frequently and perhaps as often as weekly during the spring runoff period.

Overflight of the right-of-way by aircraft taking maintenance personnel to compressor and meter sites can be used to augment the line patrol programs. The maintenance flights will be able to fly at altitudes in excess of I,500feet. Line patrol flights ideally should be at 100 to 150 feet above the right-of-way. During periods when flight at this altitude may disturb wildlife, the aircraft line patrol could be made at an altitude of 500 feet and a lower altitudes only when necessary to accurately define a condition on the right-of-way which appears suspect from the higher elevation.

With respect to aircraft related facilities at the planned district base locations, it is expected that hangar space and storage owned by others will be available for the applicant's aircraft. However, if sufficient accomodations are not likely to be provided by others, then hangars will be built by the applicant during the construction phase. Aircraft fuel storage will be provided at each compressor station air-strip and most helipads. Also a heated shelter which can be used by personnel in an emergency is planned at airstrips and helipads and a vehicle will be available for transportation of personnel from the landing strip to the compressor station.

In order that flights can be made to airstrips in severe weather conditions aircraft and airstrips will be equipped to

instrument flight rule standards.

For warehousing and storage of spare parts, materials and supplies, main storage facilities will be located at each district headquarters with secondary facilities at compressor stations and other storage sites. A modular spare parts replacement system and a centralized shop servicing program will be established to minimize maintenance in the field. Wherever feasible we will make purchases from local suppliers, vendors and manufacturers and each district headquarters will receive, store and act as the distribution depot for most spare parts, materials and supplies that are required for the particular district operation.

Right-of-way storage sites for such things as gravel and line pipe will be established as required. The warehousing and storage of spare parts, materials and supplies will require four main types of facilities. Firstly, there will be indoor storage areas for such items as electrical and mechanical instruments, repair parts, cleaning supplies and paint and to provide shelter for work equipment.

Secondly, outdoor storage areas will be for the storage of large items,such as line pipe, large fittings, valves, pipe skids, and river and swamp weights. Granular backfill stockpiles will be established adjacent to each compressor station site and possibly at other locations.

Thirdly, fuel storage facilities

which will be established at various locations along the pipeline. The fuel storage facilities in notthern areas which are generally those areas in a sensitive terrain region, will vary in capacity depending on location and accessibility. Compressor stations which cannot be adequately serviced from commercial sources will have facilities to store sufficient fuel for up to one year of normal operations and for emergencies.

Fourthly, propane storage will be at compressor stations which require propane for gas chilling. With respect to deliveries of fuel to those locations and propane to those areas having all of which have all weather access highways, the storage tanks will be replenished as the need dictates keeping in mind that there should be sufficient supplies at each location to meet any emergency situations and to provide a reserve supply.

For fuel storage sites in sensitive terrain regions near the Mackenzie River or the Beaufort Sea, it is proposed that fuel will be barge transported during the summer months. Where the sites are not close to wharf facilities, the fuel and propane requirements will generally be barged transported to storage tanks at the wharf facilities to be stored until such time as conditions permit the transportation of fuel to those sites.

Finally, under the heading

of equipment I would like to talk about fire,safety and survival equipment.

The safety of operations and maintenance personnel will be maximized by intensive training in the operation and use of all stationery and mobile facilities and by the provision of safety and emergency equipment. The applicant will , where conditions dictate, provide personnel with northern survival training, special cold weather clothing, communication facilities linked to the gas control centre, automatic radio locator equipment, food rations and emergency shelter. Where appropriate, all aircraft and ground vehicles will carry a full complement of survival equipement. Each compressor station will be equipped with a gas detection system, alarm system, fire detection system and automatic fire extinguishing system. Normal safety equipment such as first aid equipment, breathing apparatus and hand operated fire extinguishers will be located at strategic locations within each compressor station and communications site. Each district operations base will have equipment for evacuating injured or sick personnel from all points in the pipeline in its district. Where local firefighting and emergency equipment and forces are available, consideration will be given to having the applicant'support such facilities.

I mentioned earlier that Mr. Fielder, using the projector for charts and tables would describe in more detail the organizational

structure, the personnel and equipment we propose. I think, Mr. Marshall, that presentation might fit in best just at this point.

MR. MARSHALL: Thank you, those are the charts and tables that are at the back of 13 B?

A That is correct.

MR. MARSHALL: Mr. Fielder.

WITNESS FIELDER:

A As Mr. Hurd mentioned, we thought it might be useful for clarity to stop at this point and just briefly repeat some of the things that he has already said but in a pictorial fashion. This map shows the boundaries of the divisions and districts Mr. Hurd referred to. The northern division is of course of most interest to this inquiry and you will see that it has been subdivided into three districts with headquarters in Inuvik, in Norman Wells and in Fort Simpson. The operations headquarters for the whole system is planned to be in Calgary.

This chart portrays the manner in which the districts, down here the divisions and operations headquarters are ranked, Now, you will see that operations headquarters are in the number one spot followed in the hierarchy by divisions and districts.

The personnel who work in each division will be supervised by a division

manager who in turn will report to the director of operations. Reporting to the manager of the northern division will be the administrative assistant who is responsible for personnel, public relations, safety and training programs and the clerical work required in the division.
Also reporting to the division manager is the division engineer who is responsible for the resolution of operating, technical, environmental, problems and the maintenance of lands and rights-of-way.

The superintendents of the three districts also report directly to the division manager.

The southern division is organized in the same manner but has only two districts.

This slide shows the manner in which the personnel in each district are organized. The district engineer, the clerical group and the aviation group all report directly to the superintendent in a support role. The Maintenance supervisor who is responsible for maintenance of the pipeline and right-of-way as well as some station and work and transportation equipment also reports directly to the superintendent as does the chief technician who has a staff of controls, communication, measurement, electrical and mechanical technicians to carry out station maintenance.

This table, 212-D shows the anticipated personnel requirements for the Northern Division for the first five years of operation. You will note that 217 people -- that's 208 in the districts and 9 in the divisions -- will operate a total of 18 compressor stations and 1,314 miles of pipeline north of 60 degrees north latitude in Canada during years 4 and 5. The year designated one on this chart is the first year that gas flows through the pipeline system. It's our intention, however, to use the construction period as much as is possible as a training ground for permanent staff. Many of the people required to fill the O. & M. positions you see on this chart will therefore be hired up to three years prior to the year designated one.

During the period when the pipeline is not being constructed, in the summertime in the Arctic, for example, some of these trainees will be used to monitor the right-of-way on which line has already been constructed.

This table 212-E shows a comparable breakdown for the Southern division.

The following three tables 311-A, 311-B, and 311-C, provide a breakdown of the many types of ground transportation and work equipment which are expected to be required in the three northern districts in Canada. Much of this equipment will be surplus at the end of construction and will be overhauled as required for use during the operation and maintenance phase. In the Inuvik District, please

note that the equipment will be stored at each compressor station location shown across the top, whether or not this station has been constructed, so that the right-of-way is travelled as little as possible. Note also that L.G.P.s, standing for low ground pressure vehicles, and air-cushioned vehicles which we refer to as A.C.V.s are also listed. I plan to make a special presentation dealing with these types of equipment a little later.

Q Thank you, Mr. Fielder. Mr. Hurd, perhaps when we get the lights back on you could continue then with the description of the startup plan.

WITNESS HURD: Yes. Very briefly, Mr. Marshall, just to highlight the proposed pipeline and compressor station startup plan, the startup plan are the operations which could be used for taking the pipeline from the point of post construction to becoming a fully operating pipeline system. Prior to startup, operating and maintenance personnel will be thoroughly trained and familiarized with the operations procedures and with the equipment forming the pipeline. As sections of the pipeline are completed, continuous maintenance will be conducted as required. A written startup procedure will be prepared and provided to personnel for each facility before actual startup of that facility.

Now firstly, after satisfactory inspection of the line and calibration of the meter stations, and after receiving clearance from the

gas control centre, the line will be purged of air by filling it with natural gas. In preparing the compressor station facilities for natural gas, the high pressure natural gas piping will be tested and the emergency shutdown controls and the leak detection systems will be activated. Any liquid or dirt drawn from the scrubbers and station header piping will be collected in a common blow-down tank to avoid any emission of material which might be harmful to the environment. When natural gas becomes available from the line, the compressor station purge has been completed and an acceptance inspection has been made, operations personnel will carry out the pre-planned startup program to bring the compressor station into operation. The fuel system will be pressurized, turbine-driven generators will be activated, air compressors will be started, station raw water and treated water will be tested, and finally the compressor station units will be started up and all pressure, temperature, vibration, and speed signalling devices checked, and operating limits adjusted.

Technical personnel who will be at the compressor stations on a 24-hour basis until the applicant is satisfied that all station equipment is performing to specifications, will closely monitor the operating compressor stations after startup to ensure that any defects will be remedied expeditiously.

Next, to highlight briefly the routine operations and maintenance procedures. The proposed communications system will include

equipment to monitor operating parameters, co-ordinate field operating and maintenance personnel and aircraft, co-ordinate gas quantity and quality demands, and provide information on local conditions along the pipeline. Maintenance of these systems will utilize modular unit replacement of defective parts in the field, with repairs to be carried out in the applicant's work shops or by the manufacturer or service organization.

The gas control centre will conduct flow studies to optimize the use of the pipeline and to ensure that gas quality standards are maintained, and will have a predominant role to play in the initiation of established emergency procedures when an emergency situation is communicated to it by its monitoring system.

The division headquarters will administer and co-ordinate matters concerning division personnal relations, employee safety training, public relations, engineering, and the environment maintenance. The preparation and implementation of contingency plans for line breaks, station outages and fires will be a combined effort of both the division and district headquarters. Each district headquarters will be the co-ordinating centre for all operations and maintenance activities within that district, including the inspection, maintenance and repair of the line, right-of-way, compressor stations, communication sites, line valves, meter stations, river crossings, and erosion control facilities, the

monitoring of Cathodic protection system, the maintenance of vehicles, roadways, wharves, air strips and equipment and the conducting of line patrols. A district maintenance shop will serve as the central maintenance depot and mobilization centre for district maintenance personnel and equipment. A typical district maintenance base will include a vehicle and heavy work equipment service area, an area for welding, a machine shop, a repair -- a mechanical repair shop, and facilities for electrical controls and communications equipment repairs and servicing.

With respect to compressor stations, under normal operating conditions the routine operating functions of starting, stopping, and controlling the output of compressor units and refrigeration equipment to maintain station throughput, plus the recording of operations data will be under the control of the remote command of the Gas Control Centre.

The physical functions of servicing compressor and refrigeration units and the auxilliary support systems will be performed by maintenance personnel during their routine visits to the stations. To accomplish this, maintenance programs will be initiated to schedule inspections and repairs of equipment and controls at regular intervals before deterioration of any individual unit or control sequence results in an emergency shutdown.

Further, predictive maintenance programs developed from trend analysis of the maintenance information system data, plus mechanical inspections,

and gas turbine refrigeration equipment and compressor performance tests will permit the scheduling of maintenance inspections and programs to replace such things as bearings, and to clean fuel nozzles and compressor blades.

Technical specialists located in the applicant's operations' head office will be available to advise and assist on operations and maintenance problems, when necessary.

For repairs resulting from major breakdowns, modular spare kits -- spare parts kits will be available in the district operating bases. Such items as complete combustion liner kits, gas generator sections, and turbine rotors, will be replaced on site. Consumable spare parts and supplies that are used in routine maintenance will be stored at the stations.

With respect to right-of-way maintenance, the right-of-way varies topographically, environmentally and climatically, and maintenance procedures must be developed to meet local conditions in each district operating base. In the Norman Wells and Fort Simpson Districts, there will be considerable stretches of muskeg terrain and discontinuous permafrost. As the gas will be chilled in most of this area, any necessary excavation around the line will encounter frozen soil and special procedures will be required for any excavations.

The remainder of the pipeline in the Northern Division will carry chilled gas through

sensitive terrain regions. These regions will require particularly careful techniques to promote successful re-vegetation after local maintenance and repair procedures. Gravel for any necessary backfilling of excavations will be stockpiled at intervals along the pipeline right-of-way. Surface access to points along the right-of-way in permafrost regions will be restricted during the summer months and therefore helicopter support will substitute for overland travel,wherever possible.

During the summer months overland movement with heavy maintenance equipment will be undertaken only if severe right-of-way damage is apparent, or if the security of the line is threatened and there is no other way to transport men and equipment to the point on the right-of-way where they are required.

Where corrective measures can be safely postponed, maintenance will be delayed until freezup. Where the line passes through drainage areas, instability of the surrounding terrain can be controlled by the use of pipe drains to remove excess water. Grouting will assist the sealing off of spring flows and sheath piling and rip-rap can strengthen unstable conditions. Unstable slopes which may develop on or close to the right-of-way will be monitored and checked regularly. Surface water which may flow across or down the ditch line will be controlled by terracing, gravel fill or re-vegetation.

The right-of-way will be

seeded during the spring following construction. This will provide the initial plant cover on disturbed portions of the right-of-way, and also on borrow pits and haul roads. It will be necessary, however, to maintain close observation of the success of re-vegetation programs during the first summer, as the backfill crown settles and compacts, it may prove necessary to re-seed portions of the right-of-way during the fall of the first post-construction year. Fertilization will be required to obtain a suitable grass cover. The status of re-vegetated cover will be maintained by means of trained obervers in the line patrol aircraft and large-scale aerial photographic sampling techniques. It may be necessary from time to time to make ground checks on areas suspected of a decrease in the plant cover to confirm the need for remedial measures.

The line patrol, as I mentioned earlier, will assist in the identification of unusual occurrences on or in the vicinity of the right-of-way, and will permit early repairs of any defects.

The conventional type of line patrol is by aircraft. Where there is a possibility of disturbing wildlife by aircraft patrols, the patrol program may be suspended -- may be supplemented by ground patrol carried out in a small vehicle suitable to the terrain of the particular right-of-way being patrolled, or on foot by at least two specially trained individuals.

All patrols will be under the supervision of the district superintendent, who will ensure that the timing of the patrols reflects any known environmental facts peculiar to the area being patrolled.

The ground patrols will include inspection of all above ground facilities on the right-of-way and river crossings, backfill on the line, monitoring systems,and drainage control measures.

The combined air and ground patrol on scheduled programs will facilitate the proper organization of maintenance work throughout the year so that ground transportation for maintenance purposes in areas of the pipeline will be kept to a minimum.

Access roads will be maintained regularly to insure that they will be capable of use when required. Airstrips and related equipment will be maintained in a serviceable condition throughout the year. Attention will be given to drainage measures to prevent any ponds of water from forming on or adjacent to the airstrips which may attract birds or result in soft spots or ice that would hinder aircraft operations.
To some extent, the pipeline company's equipment and manpower may be used in this work. But it is anticipated that much of such work will be contracted to local contracting companies where those services are available.

Mr. Marshall, one of the Pipeline Application Assessment Group requests for supplemental information dealt with monitoring and I would suggest that this would be the place to highlight our response to that question.

MR. MARSHALL: Fine, that is question number 55, sir, in the exhibit 70.

A Question 55 read and I will read through the question first. "The applicant is requested to list and describe performance monitoring procedures that he would apply where necessary and particularly procedures for repetitive or instrumental measurement of such things as sediment concentrations in water, toxic materials, slope movement indicators, permafrost regression or build up, pore pressures, flow velocity in culverts, fish and benthos populations, mammal and bird populations, progress of vegetation growth and other parameters refered to in guidelines one to nine".

Our response, and I will summarize it very briefly, it is contained in the volume that has been circulated, I will summarize it very, very briefly, was performance monitoring will be carried out using three approaches. The first is the normal pipeline right-of-way and auxilliary facilities monitoring which is described in section 13 B -- which is usually done by aircraft but sometimes by walking the right-of-way.

The second technique involves the monitoring of known critical areas such as slopes and usually would require instrumentation to provide information on critical factors such as pore pressures in the case of slopes.

The third approach proposed

in our response involves the highly detailed monitoring of changes in specific and carefully chosen areas where a great deal of data has been obtained on environmental factors, such as wild life, vegetation, water flows, etc. The results of this detailed monitoring will be extrapolated to similar areas along the pipeline.

The first type of monitoring, the line patrol has been used extensively in Canada. In areas where environmental disturbance could be caused by low flying aircraft, overflights will be timed so as to minimize impact.

The second type of monitoring involves a watch on such factors as slope stability, pipe movement, ground thermal regime, foundations and flow velocity in culverts.

To deal first with slope stability, long term instrument monitoring will be considered for all marginally stable slopes. The monitoring system will consist of instruments and markers which will be read periodically as part of the pipeline monitoring program. The principle instrument used to monitor the stability of slopes will be piezometers which will be installed in drill holes at the depths where changes in the pore water pressure would be of concern. Subsurface temperatures will be measured at critical points on the slopes using strings of thermistors, diodes or other temperature sensors installed in drill holes. Slope indicators will be used to measure downward

movement of slopes particularly where long term creep could disturb the integrity of the pipeline. Surface movement will be monitored by photogrametric methods using aerial photographs of the slopes on which photo identifiable surface markers have been installed.

For pipe movement in previously identified critical areas the pipe conditions will be monitored regularly to provide early detection of any detrimental conditions of frost heave, bouyancy and settlements. The movement can be measured using marker rods. For ground thermal regime, ground temperatures will be measured with strings of temperature sensors installed in intervals down a drill hole and read manually, automatically or remotely. At compressor stations all ground condition monitoring instruments will be read manually by operating personnel. Pipe movement, if any , and ground temperatures will be recorded.

For flow velocity in culverts the water velocity will be monitored where any potential for fish disturbance has been identified. A maximum head water level corresponding to the design flow for fish passage will be determined and actual post construction peak head water levels will be recorded periodically to insure that the design headwater load is not exceeded.

The third type of monitoring is well illustrated by the intensive work done at Chick Lake where we have conducted monitoring

studies for the past two years. We plan to select futher sites when approval is granted and believe that government monitoring sites along the upper Mackenzie which may be created for monitoring the impact of the highway may also provide valuable information. The program at Chick Lake monitors vegetation, fish, both in Chick Lake and on the Donnelly River system, mammals and birds.

MR. MARSHALL: I take it, Mr. Hurd, that takes us to maintenance of measurement facilities?

A Yes, Mr. Marshall, that is correct.

To deal with that subject, a detailed maintenance and inspection program of the measurement equipment will be developed once the actual equipment has been finally selected and installed. A tentative program would include one routine inspection of the major meter stations at the receiving and delivery points and of meters at compressor stations. Circular charts on meter recorders will change automatically each 24-hour period and will be collected and replaced weekly. Meters will be zeroed at receipt and delivery meter stations and will be calibrated monthly at major meter stations and semi-annually at compressor stations. Meter runs will be removed for inspection and gas quality sensing equipment will be inspected and calibrated as experience dictates.

To deal next with waste

disposal. Maintenance personnel will regularly conduct tests of clear sewage effluent to insure compliance with Government water standards. The sludge removed in the biological sewage treatment process will be incinerated. Maintenance personnel working at compressor stations will be required to incinerate all combustible solid waste and bury all non-combustible waste in appropriate locations. The waste generated at district and division headquarters and personnel housing will be generally domestic waste comprising combustible refuse from the offices and shops and the normal residential wastes of garbage and sewage. It is expected that such sewage treatment and waste disposal will be integrated with community facilities.

Finally, water treatment. A fresh water source for each compressor station will be located and developed during the construction phase of the system. Where necessary, the maintenance crew will haul water from a supply source in an insulated and heated water tank to refill storage tanks at the stations after treatment by portable water treatment units.

I would like to deal next with contingency planning and first with major pipeline repairs.

A part of contingency planning must consist of pre-determined plans of action to be utilized in the unlikely event that a major pipeline break occurs. The following will describe in a general way the conditions and the considerations and the main courses of action which would be required in the case of a major pipeline break.

Firstly, no single emergency repair contingency plan can be developed for the entire pipeline because of the wide range of physical conditions encountered along the pipeline, and the seasonal variation of these conditions. Accordingly, specific contingency plans for shorter sections of the line will be prepared. Information compiled prior to and during construction will be available and will include final line route and profile, location of access roads to the right-of-way, location of facilities such as compressor stations, block valves, air strips, type of terrain and sub-surface soils, depth of cover, types of backfill material, and details of specific construction provisions, location and size of backfill material storage sites and borrow areas, hydrological data and the location of water bodies suitable for aircraft use, and reference data sheets specifying local environmental concerns and related protective measures.

Each sectional contingency plan will be in the form of standing orders listing the manpower, materials and equipment needed to affect a major line repair of various magnitudes and the

sequential steps for their utilization.

Recorded data peculiar to each sectional plan could include -- and the list is complete in Section 13 B, Mr. Marshall, I'll pick just a few examples from that list -- the location and content of the equipment storage depot nearest to the line section, the optimum routing and method of transportation of men and equipment from these depots to points on the line having regard to the different seasonal and environmental constraints, lists of the locations and quantities of pre-tested pipe lengths, heavy repair equipment units with loading and dispatch sequences for their transport by road haul units and/or low ground pressure units.

To go on with the list, the list will include also lists of regional contractors outlining their capabilities and the possible assistance that they might be in line repair. Lists of regional agents of governmental bodies to be notified in emergency situations and identification of specific local human and environmental concerns and procedures for emergency use of land adjacent to the right-of-way. The transportation of men and equipment will be by existing all-weather roads to the extent possible, and to areas not so accessible by aircraft in order to cause the least disturbance to sensitive terrain. Emergency transportation in soft terrain situations could be affected in the following manner:

(a) with the exception of pipelayers, backhoes, dozers and replacement pipe, all of the equipment

required in a major line repair operation can be transported by helicopters. The heaviest loads which cannot be transported by any type of helicopter available at the present time is the chassis of a pipelayer. The low ground pressure transport units proposed for the pipeline can haul the chassis of a pipelayer with the ancillary equipment being hauled by helicopter or other low ground pressure vehicle.

The air cushioned vehicle will be based in Inuvik and will be used where applicable in emergency situations within the Northern Division to transport heavy equipment over rivers in flood stage. A break consisting -- a break resulting in the escape of appreciable quantities of gas and its location will be detectible from changes in the data shown continuously at the Gas Control Centre. Upon such detection, the pertinent specific contingency plan will be implemented through a sequence of events which could be as follows:

(a) First of all the stations will automatically shut down

(b) The Gas Control Centre will direct investigation personnel to the location of the break.

(c) The Gas Control Centre will then notify the manager of the relevant division, gas producers, users and shippers, and agencies of government

(d) The support supervisor will immediately dispatch the required -- the personnel required to load and transport materials and equipment to the repair site.

On arrival at the line break,

the repair supervisor will report the location and the nature of the break,and the conditions at the site. The repair crew will then report on the extent of any gas flow from the break, ensure the closure of mainline block valves, open blow-down valves as required to hasten the depressurization of the damaged line segment,and lay out the repair site in anticipation of the arrival of repair equipment and materials.

Then sufficient additional maintenance personnel will be dispatched to the designated equipment depot to man the first 12-hour shift or repair operations. A second complete crew will be provided to permit repair operations to continue on an around-the-clock basis until the repair is completed.

The repair materials and equipment will be dispatched from the depot in a sequence related to the order of their required use at the repair site, beginning with terrain protective mats, any necessary repair site camp equipment, including water supply and waste disposal units, and other helicopter transportable equipment indicated by the specific contingency plan.

In the absence of suitable flying conditions, this equipment will be transported by the combination of road haul and low ground pressure vehicles over the routes indicated in the sectional contingency plan for the prevailing environmental conditions. The pre-tested replacement pipe sections and the heavy equipment required for excavation and

take a break at this point. It's kind of a natural break in the presentation. Mr. Goudge has suggested that they are ready for coffee.

THE COMMISSIONER: All right, we will break for coffee.

(PROCEEDINGS ADJOURNED FOR FEW MINUTES)

(PROCEEDINGS RESUMED PURSUANT TO ADJOURNMENT)

MR. MARSHALL: Mr. Commissioner, at the coffee break you expressed an interest in the reports that Mr. Fielder had referred to in connection with his Russian trip, and that Mr. Scott had made reference to. Mr. Fielder's report is entitled:

"A Report on Trip to U.S.S.R. of the Canadian Gas Working Group, November-December, 1974."

We'll file a copy of that as an exhibit.

The other report which we have a copy of in the office upstairs, is entitled:

"A Report on Trip to U.S.S.R. of a group of Canadian experts representing the Canadian Gas Drilling Production Processing and Pipe-lining Sub-Groups, November-December, 1974."

This is a draft report, it's prepared by the government, as I understand it, and very recently -- I think it was last week -- they got out the final version of the report. We can, if you like, obtain a copy of that and file it, if that's your wish.

THE COMMISSIONER: Would you, please?

MR. MARSHALL: In the meantime --

MR. SCOTT: Will that be filed today, Mr. Marshall?

MR. MARSHALL: Mr. Fielder's report can be filed today; the other report is still in draft form, but if you'd like to have the draft filed, that can be done, I suppose. It might be better to have the final report, since we know it exists.

MR. SCOTT: It would be better to have a draft report soon than a final report later.

THE COMMISSIONER: Well, would you file Mr. Fielder's report and the draft, and then file the final report when it's available?

MR. MARSHALL: Yes, sir.

THE COMMISSIONER: Thanks very much.

(MR. FIELDER'S REPORT ON VISIT TO U.S.S.R. MARKED EXHIBIT 124)

(DRAFT REPORT OF GOVERNMENT OF CANADA ON ABOVE VISIT MARKED EXHIBIT 125)

MR. MARSHALL: Mr. Hurd, if you would continue with his description of the stirring of paint for the coloring compressor stations, various hues and other such matters which seem to be of such interest this morning.

WITNESS HURD: Our plans to paint the stations, Mr. Marshall, are to use a color of paint to render them invisible.

(LAUGHTER)

Mr. Marshall, we had just dealt with the section in 13 B which was contingency planning, and that part of contingency planning which dealt with major line repairs. Two of the questions asked by the Pipeline Assessment Group relate to that subject, and it seems that this might be a good place to insert some highlights of our responses to those two questions.

Q Would you begin then, Mr. Hurd, with response to question No. 22,

"Off-road vehicular traffic required for contingency repairs."

A Yes. That question was a series of questions. The first had to do with the frequency of pipeline ruptures. To highlight our response just very briefly, the statistics on the frequency of pipeline ruptures on some 13,000 miles of large diameter pipeline in the U.S., indicate an

average of some .077 ruptures per 1,000 miles per year. On the basis of these data, the portion of the Arctic Gas pipeline located in the north might experience one break approximately every 10 1/2 years.

Reports obtained from three major Canadian gas transmission systems operating approximately 7,000 miles of 30-inch to 42-inch pipeline for a period of 17 years yields statistics which indicate that the portion of the Arctic pipeline which lies within permafrost areas might experience approximately one break every 9 1/2 years.

The above statistics, when applied to the applicant's proposed system, are believed to be conservative, particularly because of the fact that the most serious concern in the south-- that is damage by outside forces -- will be considerably less serious in the north due to the comparatively limited activity in this area by others.

The U.S. statistics indicated that the cause of approximately one-half of all reported ruptures has been outside force, and particularly equipment operated by outside parties. In addition, material specifications for this system, are based on the highest standards yet developed in the industry. The risk of corrosion is much less in a refrigerated system installed in permafrost soils where liquid water cannot exist, either in the inside or the outside of the pipe while it continues to operate. Both these factors will reduce the likelihood of a failure in the main pipeline.

It is anticipated that these factors will tend to limit rupture incidents to perhaps one in 20 years.

The question dealt with the seasonality of repair. To summarize very briefly, spring and summer seasons are the periods when damage probability will be the greatest, and repairs most difficult.

THE COMMISSIONER: Excuse me, Mr. Hurd just stopping you for a minute. The lifetime of this pipeline is 20 years.

A The financing assumes such a lifetime, yes. But it will operate much longer.

Q Yes, the proposal before us which we've discovered is subject to change.

A Yes.

Q Did you just say that the figures you've cited lead to the conclusion that you would expect then one rupture only in the lifetime of this pipeline?

A Within a 20-year period is our best judgment of how we should apply southern statistics to the portion of the pipeline in the north, yes sir.

Q From 60th Parallel north?

A Yes.

Q Fine. Go ahead then.

A We were talking about

the seasonality of repair, and saying that the spring and summer seasons are the period when the probability is the highest. The company's mainline break repair plan would consider the types of terrain, the locations and the season in which the work must be done, in other words it will take into account the probabilities are highest in the spring and summer when repairs must be done during those seasons.

The question then dealt with equipment required for repairs. The most serious risks to terrain would probably be encountered during the summer season when the active layer is at a maximum depth, and heavy rain may have made rivers and streams difficult to cross. To illustrate the quantity, type and use of repair equipment required, a difficult situation is described in the response to this question 22, and the use of the equipment which might be used is illustrated.

The failure was assumed to be a break some 220 feet long at Milepost 250 on the Yukon coastal plain between compressor station sites CA-05 and CA-06. It is assumed to have happened in late summer following heavy rains when the Crow and Trail Rivers, but not the Firth River, are fordable with L.G.P. vehicles. The repair equipment would be an air cushioned vehicle with a load capacity of about 25 tons to assist in moving equipment and material across the Firth River. It would include several type D, and E, helicopters, to move -- which would move to the station site -- to the break site

to transport personnel and small equipment. It would include an L.G.P. vehicle, backhoe and blade from station CA-05 and CA-06 which would proceed to the rupture site at the earliest opportunity, each loaded with terrain protective mats. The machines would be used to excavate around the ruptured section,to assist in lowering the replacement section of the line into the prepared ditch, and to backfill after completion of repairs.

Two side boom tractors would be required to place pipe in position for welding, and to assist in lowering the completed replacement section into the excavated ditch. These could both be hauled from one station if time permitted, or one from each of the stations. They would probably be transported on 40-ton L.G.P. vehicles. Again, transportation could be affected with the air cushion vehicle if circumstances required.

There would be an L.G.P. crane rated at some 20 tons, although possibly not essential this piece of equipment located at station CA-05 would probably be moved to the site to move pipe, welding machines, pumps, etc. , and to assist in lowering in the completed repair section. It would require air cushioned vehicle assistance to cross the Firth River.

There would be a 40-ton L.G.P. vehicle to haul the two side boom tractors to the repair site and to haul in six 40-foot lengths of replacement pipe. There would be a 10-ton L.G.P.

vehicle. Although these vehicles may not be required, but depending on the availability of helicopters, they could be used to transport small tools and equipment to the repair site. Not more than one trip each way would be anticipated.

There would be miscellaneous equipment including some portable camp equipment. The main personnel accommodation would be provided at station CA-05 and CA-06.

The heavy work equipment would be left on the site after completion of the repair and moved when winter conditions prevailed in order to ensure that damage to the vegetation layer was held to a minimum. The case selected and described is perhaps the most difficult repair situation on the proposed pipeline system, from the standpoint of damage to the terrain. For this reason, only the one case was described in the response to the question.

It's clear, of course, that the movement of heavy equipment to the site of repair work and the work at the repair site will damage the vegetation layer. We believe, however, that the surface restoration procedures are quite adequate to repair this type of disturbance in the same manner that services will be restored and revegetated following the initial construction of the pipeline.

The question asked also about engineering and other considerations involved in selecting equipment, and besides the obvious considera-

tion of the ability of that equipment to do the work, briefly the response listed firstly that there should be minimum unit weight on the ground surface. We pointed out that we would propose to use aircraft as much as possible so as to minimize ground traffic over sensitive areas, and the answer pointed out also that the applicant would station certain types of heavy work and transport equipment at locations selected so as to avoid long hauls over sensitive terrain.

We pointed out also that a standard type of vehicle would be selected.

The question asked about the technical specifications for a series of L.G.P. vehicles. Mr. Marshall, there are several pages of technical specifications for L.G.P. vehicles included. I would propose that we should not read each of them into the record here, they are all included in the response to the question.

Q I think counsel would be eternally grateful if you would skip the detailed technical specifications. Mr. Fielder will be showing some photographs, I think, will he not?

A Yes, he will.

Q Of these types of equipment. Fine, Mr. Hurd, that deals with the response to question No. 22, does it?

A There is a tag end after that, Mr. Marshall, if you'd like me to cover that also.

Q Certainly.

A The question dealt finally with what they called the seasonality of vehicle movements.

The response, our response to that question referred first of all to the response to subsection of this question 22, in which it was determined that the frequency of the need to make major repair-- pipeline repairs is very low, perhaps once in twenty years. The probability of its occuring at a location during a season inwhich critical environmental sensitivities would be a serious consideration, is of course very much lower.

In the event however, that major repairs are necessary at a location which is environmentally sensitive there are several measures which will minimized distrubance to birds, mammal and fish populations and which the pipeline company would propose t o utilize. These measures would include -- would use air travel to and from the site by routes which as much as possible would avoid areas where disturbance might be caused.

Ground travel will be minimized by careful planning. Any repair work which can be delayed until after the sensitive season would be delayed.

Mr. Marshall, that completes question twenty-two.

MR. MARSHALL: The other question in the Assessment Group's Report which you wanted to deal with was number 54, "Contingency Plans for River Crossings". Perhaps I might just save your voice and read the question, Mr. Hurd.

A Fine.

Q The Applicant is

requested to indicate the contingency procedures that he would use for repairs to the pipeline and major river crossing using that of the Peel River as an example. Included should be estimates of the amount of natural gas escaping before the affected pipeline length can be sealed off and the possible toxic effects of this leakage on aquatic organisms downstream for both summer and winter breaks and possible hazards involved.

Would you go on Mr. Hurd, to deal briefly with the response that was given to that? question?

A Yes, Mr. Marshall. The response points out first, that since the filing of the Applicant's -- of the application in March of '74, studies have shown that it is desirable to install dual pipelines at certain major river crossings. So that what we believed to be a very small risk before, is now even smaller.

However, to illustrate a repair procedure, the Great Bear River crossing was selected as an example. And the response concentrates on a major rupture which of course would be detected very quickly in the Great Bear River crossing.

MR. MARSHALL: Perhaps Mr. Hurd, I could interrrupt you for a moment. You might just explain which would happen in the event that -- of a break in one of the crossings at a dual river crossing at this location? Mechanically, what would happen on the system? Just to complete the picture, as I take it the question really related to the plan as originally filed was contemplated only a single crossing.

A Yes, if a break occured in one of the crossings at a dual crossing, that crossing section would be very quickly isolated by closing valves at either end of that section, and the gas flow would be diverted through the other section. That would require a very short time and the pipeline company then would not be under the same pressure to make the repair at the time that it occurred necessarily. The crossing that failed could then be replaced at that time of year when conditions are most conducive to reconstruction of the pipeline.

MR. MARSHALL: Thank you. Perhaps then you could go on to summarize the repsonse to question 54?

A Fine. We had assumed for illustrative purposes a break in the Great Bear crossing which was a single crossing. The time of year in which a failure occurred would have some bearing on the method selected to effect the replacement. If, as an example a failure occurred in the early winter, consideration would be given to installing a temporary line on the ice to resume service while a permanent crossing replacement was being constructed.

Probably the most difficult season in which a failure could occur would be during the spring break-up. That example, is therefore selected for discussion during the balance of the response. The repair procedure would be first, to install a temporary smaller diameter heavy-walled pipe while the permanent replacement pipe is being constructed. The pipe and equipment would be transported from Norman Wells and

adjacent compressor stations and a gravel pad would be constructed if it was necessary to provide a suitable work site on one or the other banks of the river.

A lesser amount of equipment would be moved to the south side. The pad would be constructed on the north side and the major equipment moved in there. A lesser amount of equipment would be moved to the south side of the river and would be used to assist in pulling the string of pipe across the river. The pipe would be selected so that it had a negative bouyancy of about 25%. Guyline cables would be connected from winch tractors to the pipeline in intervals during the pull operation to prevent the pipe from moving downstream with the strong currents. While the pipe was being prepared and pulled into place, valve manifolds would be fabricated. These following major pieces of equipment are estimated to be required. There would be two one and a half yard, cubic yard backhoes, four large side booms, eight large winch tractors complete with dozer blades, five large low ground pressure vehicles and a variety of other smaller equipment together with camp facilities.

After completion of temporary line and restoration of service, the construction of a permanent replacement line would begin as river conditions permitted. The construction procedures for the permanent line would be similar to those described in section 13 A 6.5.11 of the application. The design of the replacement line would be selected after detailed consideration of site and the cause of the failure. When the permanent replacement line

is completed the temporary line would be removed and the construction site restored.

MR. MARSHALL: Mr. Hurd, just to clarify a bit for me, is the plan as amended with the filing of the amendment dealing with the Fort Simpson revision and dual crossings, now envisioning a dual crossing of the Great Bear or still a single crossing such as you have been describing in this response?

A The plan as contemplated now, is still for a single crossing at the Great Bear River.

MR. MARSHALL: Could we move on then to a consideration of unscheduled major station repairs?

A Yes.

For unscheduled major station repairs, the lock out alarms and station emergency alarms would alert any on site personnel, the gas control centre, and the relevant district office that a complete compressor station or a major unit is shut down.

As in the case of a major line repair, there will be contingency plans developed for each compressor station. As all the compressor stations will be accessible by aircraft or highways and will have equipment and at sometimes manpower on site, equipment and manpower logistics will be simpler as they -- simpler than they would be in the case of a major line repair. We will insure that

all critical spare parts are readily available so that turbine or compressor repairs will not be delayed. We will also develop a modular spare parts system so that the faulty part can be quickly replaced and returned to the company's or manufacturer's service centres for servicing.

Finally, Mr. Marshall, Section 13 B covers fires and I would like to highlight that subsection.

The company will comply with gas industry standards which have been developed to promote safe working practices and to establish emergency procedures in fire situations. These procedures include fire safety training, the use of non-sparking tools, the designation of restricted smoking areas, the granting of hot work permits for hazardous jobs and special procedures governing the operation, maintenance and refueling of heavy work equipment and the replenishment of fuel storage facilities.

Equipment to be used to fight fires along the pipeline will be stored in suitable containers for ground transport or airlift by helicopter. Transportation of personnel and equipment to the site of a fire will be by the mode which will be appropriate to meet the type and location of the fire. Contingency plans for fire fighting will be developed. Following are the general principles which the company will utilize in establishing its fire procedures.

For compressor stations, each station will be fail safe with respect of fire and gas detection and fire extinguishment. A fire detection system will sense a fire in any of the main compressor station buildings by means of photo electric fire sensing eyes and heat rise detectors, and the emergency shut down system will be activated which will shut down the station and isolate the station from the rest of the pipeline at the same time an inert gas will be automatically discharged into the building where the fire is located, displacing the oxygen content and smothering the fire.

When a compressor station fire is extinguished the repairs will follow the relevant contingency plans for unscheduled station repairs described earlier.

For fire crossing or initiating on the right-of-way, while they are on the right-of-way maintenance crews will be provided with portable fire extinguishing equipment. Even though it is extremely unlikely that a fire will even initiate much less get out of control around work areas on the right-of-way, we recognize that a fire caused by non-pipeline sources could cross the right-of-way before preventative measures can be taken and there is a possibility of soil instability developing in some areas because of the damage to the vegetation cover caused by fire. This damage would be corrected by the maintenance personnel

as soon as practical after the fire has passed. The mobilization of men and equipment for right-of-way fires will parallel that for compressor station fires. Local fire officials will be notified and advised of the situation and liason will be maintained with such officials for the duration of the danger.

For other forest or tundra fires, during the course of maintenance trips and line patrols along the pipeline, the operations and maintenance staff will look for grass, forest or tundra fires. When a fire is spotted, local government fire officials will be notified. Requested manpower and equipment which is not basic to the continuous safe operation of the pipeline will be made available to assist with the control of such fires. THe fire officials will be kept fully informed of the applicant's equipment and manpower capabilities along the pipeline.

Following a fire, the company will use conventional means of restoring the right-of-way in the non-sensitive terrain regions. In sensitive terrain regions the environmental impact caused by a fire will vary with the intensity of the burn. With a light fire likely to consume only the uppermost layer whereas a servere fire could destroy all the vegetation and humus cover. In the latter case, the burned area, unless promptly repaired, may be subjected to erosion and in regions of permafrost the possible degradation of

permafrost resulting in surface recession. All areas so damaged which are significant to the integrity of the pipeline will be promptly restored. The restoration could follow several methods depending on the size of the area and the time of year. A temporary repair could involve the covering of the damaged area with insulated preformed blankets or a matt of straw which would be held in place by nylon or wire netting. The final permanent repair will involve revegetating the area.

Mr. Marshall, I mentioned earlier that Mr. Fielder would describe in some more detail and using the projector, the types of special L.G.P. vehicles which are now available. Mr. Fielder can make that presentation now if you like and that would end the direct testimony on O. and M.

MR. MARSHALL: thank you, Mr. Hurd, Mr. Fielder?

WITNESS FIELDER:

A Thank you. Mr. Marshall, before I go to the projector, I would like to mention that the reason for this presentation is because concern has been expressed on occasion that while the use of snow roads would satisfactorily protect the ground surface during the winter construction period, that the sensitive tundra surface could be damaged if it were travelled on during the summer months when the active layer is unfrozen, and in this respect I would like to make make the following three

points.

Firstly, that as the pipeline and right of way will be properly designed and constructed, and work on the right-of-way will be rigourously inspected during construction, the need to travel on the right-of-way during the summer months for maintenance purposes is expected to be very minimal.

Secondly , in order, however, to be prepared for the unlikely event that it proves necessary to travel on the right-of-way during that sensitive period, we plan to have suitable transportation equipment stratigically located for that purpose and you saw on the chart this morning that we would store them at various compressor station sites.

THirdly, the types of available and suitable transportation equipment which may be used to get to and to work at the location at which maintenance is required can be broadly grouped as followe: there would be aircraft which would include both fixed winged and helicopter, there would be watercraft which would include boats, hovercraft and A.C.V's or air cushion vehicles, and There would be land craft in which I would include L.G.P.s, low ground pressure vehicles and A.C.V.'s the air cushion vehicles, and I would like to emphasize that the types of equipment in all of these categories are available and they are in service today. I am certain that everyone here today is familiar with both aircraft and boats so I will not

bother with pictures of that -- of those, but as we are not familiar perhaps so much with L.G.P.s and A.C.V.'s I will show a few pictures of those.

Firstly, L.G.P.'s or low ground pressure vehicles. This vehicle is called a rologon and this particular one is currently being used as the photo shows in clean up operations on the Alaskan north slope during the summer months. They are available in a variety of sizes, but for illustration a typical rologon carrying a 20-ton payload exerts a pressure on the tundra of about 4 pounds per square inch. Now, for comparison, a 180 pound man walking could exert a pressure of more than 6 and perhaps as high as 10 pounds per square inch.

These machines are also useful during the winter months. In this instance this rologon is traversing about six feet of powder snow in the Anaktuvak Pass in Alaska.

THE COMMISSIONER: Excuse me, would you just go back to the last one, Mr. Fielder? Excuse me, I was writing down what you said and I missed it, what you said before, that is. What did you say about that? I'm sorry.

A That's a rologon and it's travelling in about six feet of powder snow in the Anaktuvak Pass in Alaska.

Q The depression it creates in the snow is two or three feet, is that --

A That's what it appeared on the photograph, sir. I didn't see it myself but it indicates and perhaps emphasizes what Mr. Williams said yesterday about the means of making snow roads, they use these machines to pack down snow.

This particular photograph, which isn't very clear, shows a rologon --

THE COMMISSIONER: Excuse me, can you gentlemen see these? No, they're shaking their heads, some of them. Would it help if these lights were out? Does anyone know where the switches are?

MR. MARSHALL: If they like, there are some empty chairs over on this side of the room . You might be able to see it a little better if you moved up here.

A I'm sorry I'm unable to

move this machine, it works in one position only.

This particular photo, although it's not very clear, shows a rologon towing a 100-ton non-self-propelled air cushioned vehicle on the Mackenzie River near Inuvik. I'll show you a much better picture in a few moments of what that air cushioned vehicle actually looks like.

The foremost L.G.P. vehicle which is made in Calgary is shown in this photograph, is available with either tracks as shown, or with large balloon type rubber tires. The vehicle illustrated is called a Husky 8, and exerts a 4.6 p.s.i. (pounds per square inch) pressure on the ground with a 40-ton pay load. I included this photograph just so that I could show one of a variety of configurations into which these sorts of vehicles have been rigged up. This particular one is equipped with a 195-foot high crane with a 35-foot jib, that's a horizontal piece that goes up from the crane (it's not in the photograph) and is being used to set electric power line towers. The point here is only that these L.G.P. and A.C.V. type vehicles can be equipped with cranes and hoists and hoes and a variety of other equipment, sort of things that we would need for working on the right-of-way during the summer months.

These are photographs of air cushioned vehicles, and this is one I promised earlier to show you what it actually looks like, is being towed by the Husky 8 -- oh, excuse me, the rologon in the delta. This particular air cushioned

vehicle is not self-propelled, has a pay load of 100 tons, and is made by Arctic Systems Limited in Edmonton. Now for those who are not familiar with these vehicles, a brief word on how they work.

You will note that there is a large fan on each side of the vehicle. These fans take in air and move it down below the deck where the air is trapped between the deck surface, the sides, and the large balloon type skirts. This trapped air increases air pressure and lifts the vehicle approximately four feet off the ground with 100-ton pay load. That particular vehicle loaded would exert a pressure on the ground surface of about one pound per square inch. It is not self-propelled, as I mentioned.

These non-self-propelled air cushioned vehicles can be towed by L.G.P. or low ground pressure vehicles, here you see a Foremost Delta 3 pulling the air cushioned vehicles. Actually I'm sure it's an advertising slide because no cloud of snow back there so it's obviously not in its working position. As I mentioned earlier, the Foremost vehicles were available both with track configurations and the balloon type tires, and this particular one has the tires.

On rivers and across lakes they can be towed by boats. This is somewhere on the Mackenzie River, I don't have any idea where. It's difficult to see but there is a cable out here in front that's being towed by another boat on the river. There's

another cable out behind that's being held by another boat to stop it from fishtailing.

MR. CARTER: Mr. Commissioner, we should get a copy of this slide for Mr. Bayly to send to his client in Aklavik.

THE COMMISSIONER: Well, I missed that point.

A Some non-self-propelled A.C.V.s winch themselves along a cable, should that be a decision made to do it that way. This particular non-self-propelled air cushioned vehicle is manufactured in Toronto. It is called a Hoverjack and as you can see here it's being towed by helicopter. An air cushioned vehicle very similar to this one with a 25-ton pay load will soon be working in a peat mining operation in a peat bog near Delta, British Columbia.

Bell Aerospace Canada sells two self-propelled air cushioned vehicles called the Voyageur and the Viking. The largest, the Voyageur, the one with the red trim in the background, carries a pay load of up to 25 tons, or can carry about 30 people comfortably at speeds up to about 50 miles per hour in calm water. Incidentally the Hoverjack that I showed you earlier with a 25-ton capacity, would exert a ground pressure of about one-half a pound per square inch on the ground.

Now, stream crossings pose special problems and they can be accomplished, however, in a variety of ways, boats, of course, with air cushioned

vehicles, but a rather unique and different manner is the use of this device called a flexifloat ferry. This ferry is furnished in separate modules which can be assembled on site, and you'll see that it would also be very useful for making portable or temporary wharves. Each of the rectangular sections that you see on here, here, here, whatever, is hauled in separately and bolted together, and this particular instance it's using a cable to winch itself across a river, it could be built with this configuration and anchored and of course be used as an off-loading site on the side of the river.

This, once again, is called a flexifloat ferry.

Another method of protecting terrain during sensitive periods of the year is illustrated in the next few photographs. You heard Mr. Hurd refer to terrain protective netting. This particular device is called Mo-Pad and it's furnished in 48 separate panels which can be separately carried to the site of a problem area and assembled to provide a working service which will protect the tundra by distributing the weight of the equipment over a much larger area.

These two photographs show the MO-PAD being used in the Mackenzie Delta during August of 1972. And in the lower photograph, in this lower photograph you see the loader, that's a front-end loader carrying five and a half cubic yards of soil with approximately six and one half tons on each front wheel. You can see that it is deflecting the trackway somewhat, but not causing any deep ruts or anything like that.

This photograph shows a little more clearly, I think, the manner in which the MO-PAD sheets are inter-connected to form the sort of trackway that one would use to work from if they had to.

Now, this completes the photographic presentation, but I would like to say in conclusion, that we at Arctic Gas have not yet decided the specific pieces of equipment we plan to utilize during the operating phase, but I think it is pretty obvious that a large selection of proven equipment and material is available to us.

MR. MARSHALL: Thank you, Mr. Fielder, Mr. Hurd, and Mr. Carlson. Sir, that completes the direct evidence of the applicant pertaining to the operations and maintainence. I had indicated the other day that we would have available material pertaining to Mr. Horte's evidence. That has just reached me, sir, and I will hand it out to counsel when we disperse today.

MR. SCOTT: Mr. Commissioner, I am grateful for that. Some of the participants have indicated, as we have, our concern that the summaries are--particularily this one are very late. Three days notice,

rather than the two weeks required. The difficulty in that, of course, is that it makes it extremely difficult to prepare any cross-examination before the summary is at hand. I would hope that in the future we won't have that problem as we have had in the past week or two.

THE COMMISSIONER: Well Mr. Marshall explained the difficulty in preparing the summary of Mr. Horte's evidence yesterday, and I think it is a perfectly adequate explanation. Matters keep coming up that are referred to Mr. Horte, so quite naturally his evidence -- the notes of his evidence can't be made available when subjects are still being added to the list which he has to deal with.

MR. SCOTT: I would have thought, sir, that in the future as Mr. Horte will be coming back, it would be helpful if that is the process that my friend goes through, he should let us have the sections of Mr. Horte's evidence as they become available. Presumably the evidence he will give with respect to what has been said by the geotechnical panel has now been fixed for several weeks, and I would hope that if we can't have it all at once, we could at least have it in sections so that we will have some idea of what we are going to confront.

MR. COMMISSIONER: Right, well you'll have the weekend to work on this Mr. Scott, since it's being made available now.

Was that report of -- Mr. Fielder, your report that you read this morning on your trip to Russia, was that a summary of the report that

has now been marked as an exhibit?

WITNESS FIELDER: No, sir, it was not.

THE COMMISSIONER: Was that report that you read this morning, was that marked as an exhibit?

MR. SCOTT: Yes, it was. I think we've asked Miss Hutchinson to obtain some copies of it.

THE COMMISSIONER: Oh, I see, I see. All right. Well, we'll adjourn then until Tuesday at 1:30 in the afternoon. Tuesday, 1:30 in the afternoon. I anticipate that next week we will sit on Tuesday, Wednesday, Thursday, Friday, and likely on Staurday as well. I understand that all concerned were advised that/we might well be sitting next Saturday, and if you didn't know about that, now you know. And I am advised by Miss Hutchinson that the hotel management is working on the airconditioning equipment for this room, and if it makes you feel any better, and it may, the manager in his office is just as uncomfortable as we are. So, we'll see you on Tuesday.

(PROCEEDINGS ADJOURNED TO MAY 20, 1975)

MACKENZIE VALLEY PIPELINE INQUIRY

IN THE MATTER OF AN APPLICATION BY CANADIAN ARCTIC GAS PIPELINE LIMITED FOR A RIGHT-OF-WAY THAT MIGHT BE GRANTED ACROSS CROWN LANDS WITHIN THE YUKON TERRITORY AND THE NORTHWEST TERRITORIES FOR THE PURPOSE OF THE PROPOSED MACKENZIE VALLEY PIPELINE

and

IN THE MATTER OF THE SOCIAL, ENVIRONMENTAL AND ECONOMIC IMPACT REGIONALLY OF THE CONSTRUCTION, OPERATION AND SUBSEQUENT ABANDONMENT OF THE ABOVE PROPOSED PIPELINE

(Before the Honourable Mr. Justice Berger, Commissioner)

Yellowknife, N.W.T.

May 20, 1975.

PROCEEDINGS AT INQUIRY

VOLUME 41

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Mr. Pierre Genest, Q.C. Mr. Jack Marshall, Mr. Darryl Carter, and Mr. John Steeves	for Canadian Arctic Gas Pipeline Limited;
Mr. Reginald Gibbs, Q.C. Mr. Alan Hollingworth	for Foothills Pipelines Ltd.;
Mr. Russell Anthony, Prof. Alastair Lucas	for Canadian Arctic Resources Committee;
Mr. Glen W. Bell and Mr. Gerry Sutton	for Northwest Territories Indian Brotherhood and Metis Association of the Northwest Territories;
Mr. John U. Bayly	for Inuit Tapirisat of Canada and the Committee for Original Peoples' Entitlement;
Mr. Ron Veale and Mr. Allen Lueck	for Yukon Native Brotherhood;
Mr. Carson H. Templeton	for Environment Protection Board;
Mr. David Reesor	for Northwest Territories Association of Municipalities
Mr. Murray Sigler	for Northwest Territories Chamber of Commerce

INDEX

Yellowknife, N.W.T.
May 20, 1975.

(PROCEEDINGS RESUMED PURSUANT TO ADJOURNMENT)

MR. SCOTT: Mr. Commissioner, I thought it might be useful to all participants at this stage to tender as an exhibit a document entitled:

"Mackenzie Delta, a Summary Report of Surface Conditions".

It is a report prepared by Helen Kerfoot of the Terrain Sciences Division, Geological Survey of Canada, the Department of Energy, Mines & Resources, and is a discussion of the physical environment of the on-shore portion of the modern Mackenzie Delta, and it will be useful in view of the proposed alternate route across the delta. It is in part supplemented by recent field observations by the author, but the report is basically a synthesis of available data, both published and unpublished, that relates to the modern Mackenzie Delta. There is a bibliography and there is a map, and I thought that rather than simply indicate it's available, it might be marked as an exhibit and will be retained in the Inquiry Offices at Yellowknife for inspection by any interested participant or person.

(MACKENZIE DELTA SUMMARY REPORT OF SURFACE CONDITIONS MARKED EXHIBIT 126)

THE COMMISSIONER: So ordered.

MR. MARSHALL: Sir, you'll recall when we were last assembled that you asked Mr. Fielder for additional information as to the locations of certain gas pipelines in the U.S.S.R., and he has over the

weekend prepared some materials, some maps, and he has some remarks as well. He's had them typed up, sir, and I can distribute copies if you'd like. If it meets with your approval, I propose that he present that material now before cross-examination of the panel begins.

THE COMMISSIONER: Yes, certainly.

DONALD ERNEST FIELDER,
LEE GORDON HURD,
MELVIN E. CARLSON, resumed:

DIRECT EXAMINATION BY MR. MARSHALL (CONTINUED):

Q Mr. Fielder?

A You will recall, Mr. Commissioner, that I stated last week that there are three gas pipeline systems in the Soviet Arctic installed in areas containing permafrost. These are the Taas-Tumus Yakutsk-Pokrovsk Line in Eastern Siberia, the system I referred to last week as the Yakutsk line; secondly, there is the Messoyakha-Norilsk Line; and thirdly, the system of which I saw part which serves the Medverzhye Gas Field in Northwestern Siberia and which is sometimes referred to as the "Northern Lights" System. The presentation that was just given to you includes some maps which will help you locate those systems relative to better known places in Russia; but I can project them on the screen for the benefit of those who don't have that.

Sir, this map shows the U.S.S.R. and shows the three systems that I referred to. Firstly,

excuse me for standing in front of it, firstly there is the Yakutsk system shown up here, and it actually runs from a place called Taas-Tumus through Yakutsk to Pokrovsk. You'll have to forgive the spelling. Every time one picks up a report, Russian names are spelled differently from the last time. To help get you oriented, the Port of Vladivostok is down here, so that's in Eastern Siberia.

The second system, the one that's entirely beyond north of the Arctic Circle running from Messoyakha to Norilsk and the system that I saw part of which runs from this general area here down through Nadym to Punga where it ties into a system that was constructed prior to that time.

This map shows the Soviet grid system that I referred to last week. You see Medverzhye here, and it runs down to what on this map appears to be Igrim but in actual fact is Punga. I think it must be a town very close by, but you'll see that once they get here there is access to Moscow into the south to the Ukraine, in the Caspian and Black Sea areas as well as virtually all of Western Russia. So far as I am aware, sir, this system is shown here to the north with dashed lines to Medverzhye to Ukhta has never been constructed.

This map shows the Medverzhye area just a little more clearly. This is the Bay of the Ob River which runs up from this general area into this Bay at this point, flows into the Arctic Ocean and the Medverzhye field here running off to Punga where it ties into the system that we mentioned before nd you can also see schematically the Messoyakha-Norilsk line on the same map.

A blown up of the Messoyakha-Norilsk gas pipeline system, you can see that it crosses a number of rivers, as it runs from Messoyakha through Fakel on to Norilsk.

The Messoyakha-Norilsk system as is the case for the Yakutsk system are local in significance, that is, they are not tied to the grid system.

And once again, another blow up of the Messoyakha -- excuse me, of the Medverzhye system. You will note here also some discrepancies from some of the comments I will make in a few moments, it shows the length at 365 miles -- or --67 miles, we were told 415 miles in length and it shows that the first 145 miles will be constructed a-bove ground and that is not the case. The whole system was constructed either on ground level or else was buried.

That concludes the maps that I have to show you, Mr. Commissioner, and I will go back to the table now and tell you about those systems.

Since we met last I extracted

from the reports/of which I had copies and which described the visits of two separate groups to the Messoyakha-Norilsk system, and from another report that I had not seen prior to this last weekend which was published by the American Gas Association in 1970 and it is called, "Gas in the Soviet Union", enough information to prepare a brief description of those three systems that I just showed you on the maps.

Firstly, the Yakutsk system. The construction of the Taas - Tumus -Yakutsk-Pokrovsk gas pipeline, the first transmission gas pipeline to be built in the Arctic was begun in 1964. The distance between Taas-Tumus and Pokrovsk is 356 kilometers which is about 221 miles. And 193 of those kilometers, or about 120 miles of that length was laid above ground on support. To Yakutsk the line is 20 inches in diameter, beyond Yakutsk to Pokrovsk the line is only ten inches. This line is of only local significance in terms of gas distribution but has been a useful testing ground for construction techniques in the permafrost. The last four sentences that I have just read are quoted directly from the American Gas Association report I described earlier, except for the conversions for the metric units for which I am responsible. I am sorry that I was not able to contact any of the people who saw this system in 1973 to get any more information.

The Messoyakha-Norilsk System. To describe this system I have relied rather heavily on a

report prepared by Dr. R.S. Taylor, Ph.D., P. Eng., who visited Russia in 1973 as a member of the Canadian Gas Working Group and who worked for Arctic Gas at that time; and a report prepared by the Gas Working Group who visited in 1972 as well as the AGA report described earlier. The system was located in 1967, the design started in 1968 and by mid-1970 gas reached NOrilsk. This information is extracted from the 1970 report which differs from the 1973 report which says that the line was started in 1967 and completed in 1968. The comments that follow are taken directly from Dr. Taylor's report:

> "The first line was started in 1967 and completed in 1968. The second (looped) line was built in the winters of 1971 - 72 and 1972 - 73. Separation between the lines varies from 500 m to 4 km. There are at least four valved cross-over lines connecting the mains. The mains are manifolded on both banks of the Yenesei River, which is crossed under water by six, 40 cm lines. Besides this crossing, there are three major and 80 minor stream crossings. System length (single line) is 265 km; straight-line dist - ance to the field to Norilsk is 230 kilometers."

As I mentioned last week to you, sir, that that was quite an extension from the direct straight line length, I think I used 13% last week, and the figure is actually 15%.

The pipe diameter is 72 centimeters, wall thickness of 11 millimeters, of German low carbon steel No. 09-GC-2 steel No. 10. Operating pressure is 55 atmospheres, pressure drop along the line is 5 to 7 atmospheres in summer; 10 to 12 atmospheres in winter. There are no compressor stations between the field and Norilsk. Operating temperature is ambient temperature, that is gas at well-head enters the gathering system at minus 1, plus 2 degrees Celsius.

With a few short exceptions, the pipelines are all pile-mounted generally with bottom of pipe one meter or more above the ground surface. Piles are timber, reinforced concrete or steel pipe. Rest bars between piles are steel. Some of the exceptions are a few short test sections where the pipeline is laid on recessed horizontal supports with bottom of pipe at ground surface. The balance of the exceptions relate to stream crossings. Expansion is accommodated by V-sections about 20 meters by 200 meters, at irregular intervals that appear to be about 500 meters to 750 meters apart.

That concludes my quote from Dr. Taylor's report.

As I mentioned during my presentation last week, I was able to confirm during

the Soviet to Calgary on March 21, 1975, that the system does indeed currently consist of two 28-inch lines. That's 72 centimeters. This system is probably the most northernmost gas pipeline in the world, being laid in its entirety north of the Arctic Circle between the 69th and 70th Parallel. You will note that Dr. Taylor's Report goes into considerable detail in such areas as design, construction and logistics.

The Medverzhye to Punga system; in this instance I'll quote from my own report which was, I believe, circulated last week. The Medverzhye area contains gas reserves which are huge by North American standards, having proven reserves in the order of 14 trillion cubic meters. The Medverzhye field itself, 1.5 trillion cubic meters. For purposes of comparison, the 27 trillion cubic feet commonly stated as Prudhoe Bay-Alaska reserves amounts to less than 0.8 trillion cubic meters. Medverzhye gas production is estimated at an average of 24 million cubic meters per day in 1973 and 60 to 65 million cubic meters per day in 1974, which is about 2.3 billion cubic meters per day, is transported through a 48-inch and 56-inch trunkline system to Punga, near the Ob River where gas enters an established trunkline system extending to the Central European area of the U.S.S.R.

The first line laid had a diameter of 1,220 millimeters, or 48-inch. The loops which have been and are being constructed will be 1420 millimeter, or 56-inch. Including loops, the system consisted of about 1,500 km. of pipeline or about 930

miles at the end of 1974. The distance from Medverzhye to Punga, 670 km. or 415 miles.

Large river crossings are buried in the river bed and are dualled or twinned. When the main crossing is 1,420 millimeter (56-inch), the spare crossing is normally 1,020 millimeter or 42-inch.

The pipeline configuration is either buried or bermed. When buried the cover is normally 0.8 meters, or about 30 inches. When crossing marshes both buried and bermed configurations are used but the line is mostly buried because the water is usually only about 2 meters deep.

In permafrost areas roads are constructed by building up a gravel grade over tree limbs.

You'll recall, sir, that I described last week the terrain we overflew. I explained that the area had not been glaciated and that permafrost problems were minimal. To quote my report:

> "What we saw was an area in which conventional winter pipeline construction techniques would be utilized in Canada, as it is very similar to Northern Alberta."

Five compressor stations will probably be constructed with spacing of 130 km., or about 80 miles. This rather large spacing is considered economical there. I visited one of these stations, I believe the only one built to date, called Long-Yuganskaya. It included six 6,000 kilowatt units

(about 8,000 horsepower), each of which is able to move 18 million cubic meters per day. The station is not remotely controlled and is normally operated on a local automatic mode, although local manual is also possible. A station suction pressure of 55 atmospheres -- that's 810 p.s.i. approximately -- and a discharge pressure of 75 atmospheres -- about 1,100 p.s.i. -- are normal. Gas reaches this station using reservoir pressure (about 100 atmospheres) from the Medverzhye field. Suction temperature is about plus three degrees Centigrade, and discharge temperature about 40 degrees Celsius, which is the range of 37 to 104 degrees Fahrenheit.

Sir, I've attempted to excerpt the information you requested from the reports I have available to me and hope that I have presented the information you requested and that you find it useful.

Before I conclude, I'd like to make certain that I did not leave an impression last week that could be misinterpreted. I stated then -- and I quote:

> "We will probably not learn a great deal more from additional visits to Russia,"

and that, referring to reports prepared by others,

> "perusal of their reports did not add a great deal to our knowledge of permafrost pipeline techniques."

IN a "nuts and bolts" sense, I believe what I said to be true. However, there is one very important thing

we learned from what the Soviets have done and I think it's worth mentioning at this point. It is this -- they got the job done. That is facing Arctic temperatures, winter darkness and the extreme logistical problems associated with both the climate and the geography, they did design and are still designing, up to eight lines from Medverzhye , they did construct and are still constructing, and they are operating at this moment, hundreds of miles of gas production, treatment, and pipeline facilities in their Arctic. I consider this accomplishment to be most commendable.

THE COMMISSIONER: Thank you very much, Mr. Fielder. I appreciate your taking the trouble to put those maps together and explaining them as clearly as you have.

A You're most welcome, sir.

MR. HOLLINGWORTH: Mr. Commissioner, last week on Thursday, I believe it was, you made an enquiry about what research El Paso had done into the frost bulb technique, and my solution was going to be to have a Foodhills representative in Washington check the El Paso application, but that deed was obviated when I spoke to Dr. Harlan, who briefly appeared on the last panel, who advised me that El Paso has decided that frost bulbs won't be a problem since at river crossings their pipe is going to be coated with six inches of concrete which will provide effective insulation and there won't be a frost bulb problem. Now, that's their apparent solution.

I haven't looked further into it than accept Dr. Harlan's words to me.

THE COMMISSIONER: Thank you, Mr. Hollingworth.

CROSS-EXAMINATION BY MR. HOLLINGWORTH:

Q Mr. Hurd, where is the O &M office of the applicant?

WITNESS HURD:

A The head office or corporate office, Mr. Holingworth, would be in Calgary. Are you asking about the operating company?

Q I am sorry, I said O & M, but I did not make it very clear.

A In Calgary.

Q And how many people on your staff are associated with the operations and maintenance phase?

A Mr. Hollingworth, are you asking about the operations staff as it will exist when the pipeline goes into operation?

Q No, I am asking about it, now, Mr. Hurd.

A The staff at the moment, the full time staff consists of Mr. Carlson and Mr. Fielder who have help available to them from consulting people and from a working committee of participant companies which would add upto another 15 or twenty people.

Q But they are not on the applicant's staff as such?

A No.

Q And, Mr. Carlson, are you

presently an employee of Trans-Canada Pipeline or of Canadian Arctic Gas?

WITNESS CARLSON:

A No, sir, I resigned from Trans-Canada Pipelines last month, I am now a permanent employee on Canadian Arctic Gas staff.

Q That is as of April, 1975?

A April 15th.

Q And are you permanently resigned from Trans-Canada, or are you on loan to Canadian Arctic Gas?

A No, sir, I am on permanent staff, I have severed my connection officially with Trans-Canada.

Q Now, did any of you gentlemen prepare the operations and maintenance procedure that has been set out in the application?

WITNESS HURD:

A Mr. Hollingworth, I was responsible for its preparation in the sense that I co-ordinated and was active in an overview role and to some extent an editing role. It was prepared by a lot of people.

Q Are those people presently with Canadian Arctic Gas?

A The advisory committee made up of participant companies are still with the companies that they were with before and still are an active committee and available to us. The consultants who assisted in the preparation are still consluting to

Canadian Arctic Gas. There are others who are no longer associated with the company.

Q Well, how many people are responsible for preparation of the actual material that you, the operation that you oversaw, Mr. Hurd?

A If we included in the count the operations and maintenance committee, the number would be well over 20, approaching 30.

Q And how many of those people are with companies no longer associated with Canadian Arctic Gas?

A I can only guess, Mr. Hollingworth, without checking, I would guess some half dozen.

Q And would those people be mainly with Alberta Gas Trunkline Company, Limited?

A Alberta Gas TRunkline contributed more people to that group than any other single company, that is true.

Q Presumably because they have experience in harsh climates in Northern Alberta, is that a fair statment?

A I think that certainly it is true that Trunkline has experience in Alberta and ranging some distance north, yes.

Q And was anyone associated with Westcoast Transmission instrumental in helping to prepare this documentation?

A No one, Mr. Hollingworth, who was associated with Westcoast Transmission at that

time.

Q ANyone who is now associated with Westcoast?

A Not to my knowledge.

Q On page 19 of your prepared testimony -- I do not think that it is important to turn to it -- there is a statement made that maintenance of these systems and related equipment will utilize modular unit replacement. This is concerning communication facilities, but actually what I was more interested in, was compressor station equipment. I think that I made the wrong page reference here. I think that the statement is made that you will use modular units on compressor station repairs where possible, is that correct?

A Yes, that is right.

Q Now, does this -- do the actual compressors lend themselves to this type of repair, Mr. Hurd?

A Yes, Mr. Hollingworth, they do. A large part of the equipment that will require maintenance will be the unit and station control panels. That equipment is electronic type of equipment and can be constructed so that parts of it can be extracted from the panel and replaced with workable parts and the part then, the damaged part or the faulty part is taken back for repair at other places.

Q I am sorry, you said that these were the electronic control panels?

A Yes, the unit and station control panels.

A better example might be the gas generator itself which, in an aircraft type turbine, can be changed in a matter of hours with a working unit, and the faulty unit is taken back to the factory for repair .

Q And are you using a turbine type of compressor?

A Until the purchasing process is completed, we can't be all that specific about which type will be used at which locations. It's likely that a large number of aircraft type turbine compressors will be used, and probably a number of industrial type turbine compressors also.

Q Well, are the industrial type turbine compressors easily exchangeable as modules?

A Less so than the aircraft turbine. Usually what they call the hot blade path is replaced in the industrial type. It takes longer but the industrial type operates for much longer periods between overhauls.

Q Well, how long does it take to replace one of these industrial type turbines in the event you had to pull out one because of a malfunction?

WITNESS CARLSON: It would take up to one to two weeks with a crew of six or eight men. That is my best estimate. I can possibly get you some more details that are more accurate, but it is a more lengthy process as compared to the

replacement of a gas generator on a jet.

Q Well, let's turn to an aircraft type turbine, how long would they take to replace them on a module system?

A Trans-Canada has replaced a gas generator in about an hour and a half. We estimate normally six to eight hours with a four-man crew, and a supervisor.

Q Now, Mr. Hurd, you say that studies are still going on in this regard, but which way is the applicant leaning as to which type of compressor it's going to be using?

WITNESS HURD: I doubt if we could say at this stage, Mr. Hollingworth. Both the industrial and the aircraft are practical applications, have practical applications on this pipeline.

Q Does the industrial turbine have a greater capacity, a greater horsepower than the aircraft type?

A I believe both are available in sizes that are proposed for the pipeline system.

Q Are you sure on that, Mr. Hurd?

A Yes, quite sure, Mr. Hollingworth.

Q Now, is there any difference in the weight, supposing that you had the example of the inner guts of the turbine, if you like, breaking down, the whole engine. How much does

one of these machines weigh?

A They come in several parts. The compressor itself is the largest single component.

Q Do you recall the weight?

WITNESS CARLSON: I don't recall the weight of a compressor, but I can say the aircraft type gas generator of the type that might be considered for this project would weight approximately 3,600 pounds.

Q And would the industrial type of turbine weigh more?

A Much more.

Q How much more?

A Unfortunately, I have no experience with the type of industrial unit that is being considered. The units Trans-Canada had were considerably smaller than this. Several thousands pounds more, or heavier.

Q Well, do you mean to say twice as much, sir, or three times as much?

A I'd prefer not to guess. If you want a precise figure we could get that.

Q Well, I'd appreciate a precise figure because I'm wondering if the aircraft you mentioned in your application are capable of bringing these machines in.

WITNESS HURD: Well, Mr. Hollingworth, we mentioned earlier that the part on an industrial turbine that would be replaced is what we call the hot blade path,

which is a very small part of the total. It's the inside part that's exposed to very high temperatures. That's easily transportable by aircraft.

Q So the larger whole, if you like, would not ever have to be replaced as a unit, as a complete unit?

A OH, I doubt if we could say not ever, but it would be a very unusual occurrence to need to replace the whole unit.

Q Well, suppose such an unusual occurrence occurred, are your aircraft capable of bringing in such a unit as a whole?

A I don't know whether the aircraft is or not, it's the replacement of the unit is not that difficult a problem because very heavy equipment and machinery can be brought in over land on the sorts of vehicles that Mr. Fielder described earlier in the testimony.

Q It would be brought in by land from a wharf or from a depot, or where?

A Most of these components would be flown to a large airport and transported from there by land equipment.

Q When do you expect a decision to be made on which type of turbine you're going to use?

A It's sometime down the road, Mr. Hollingworth. The process usually involves negotiating with suppliers of equipment, receiving bids from them, determining which is the best

considering the number of units that can be supplied by any one supplier. It's not likely that that process can be nailed down until we're prepared to make commitments to those suppliers, and that follows the obtaining of a permit.

Q O.K., well let's just keep on with the air strip discussion, or airplane discussion for a moment. You've got a discussion of various types of airplanes required in your application. I should say aircraft. That's on page 12 and 13. I'm specifically interested in type C. That seems to be a fairly large plane, is that correct?

A Yes, it is.

Q And what sort of type of plane that's flying today would fall into this category?

A The Hercules, Mr. Hollingworth.

Q And what length of runway does a Hercules need to take off at full load?

A I don't know precisely what the aircraft requires. I know that runways at Normal Wells and Inuvik and at those stations where we're proposing a 6,000-foot runway, would handle the Hercules.

Q O.K., would a shorter strip than 6,000 feet be able to handle it?

A My guess is yes, but I don't know the length required by that aircraft.

Q Does anyone know? Mr. Fielder?

WITNESS FIELDER: Well, I think the 6,000-foot strip was intended for Hercules use, that's all I can tell you, Mr. Hollingworth.

Q Well, I take it from your evidence that you're saying that if a mishap occurred which required bringing in rather substantial equipment that it would be flown first to the nearest large airport, provided the Mackenzie Highway wasn't available.

WITNESS HURD: That's correct, yes.

Q And then it would be brought overland to the point of the rupture, is that correct?

A Are we talking about a compressor station failure?

Q No, I'm talking about a line failure,the heavy equipment that you would need to effect such a repair.

A The heavy equipment would be stored at compressor station sites and division headquarter sites, and would be moved from those points overland to the site of the break.

Q Would there not be any equipment that would have to be flown in then in the event of a pipe failure?

A No. It should be available all -- it is intended to be available within reasonable distances of all locations on the pipeline.

Q And this includes spare

pipe, does it?

A Yes.

Q Well, let's get onto a compressor station then. Suppose you had to bring in a new unit, a new turbine unit, as we were discussing before. Would this require the use of a large plane such as a Hercules?

A A Hercules would handle several of the gas generator units for an aircraft-type station. Probably, though, several of those units, the gas generator units would be kept in stock at places like Inuvik.

Q Have you made any final determination on that point?

A Not as to the precise number. It is pretty much conventional practice with pipeline systems to keep one for each or perhaps half a dozen aircraft gas generators in service.

Q Well, let's say that you needed a gas generator somewhere along the North Slope in the Yukon Territory, for instance. How do you plan to move it to the site where it is required?

A By -- Certainly it could be moved by land using the low ground pressure type vehicles that Mr. Fielder described.

Q Well, it couldn't be flown very successfully, could it? Because you have only one 6,000 foot airstrip between INuvik and the Alaska-Yukon border, isn't that right?

A The gas generator for an aircraft type, Mr. Hollingworth, could be hauled by the type D helicopter -- sorry, the type E helicopter, which has a sling load capacity of some 8,000 pounds and the weight of a gas generator is something roughly half of that.

Q Well, let's suppose

that you had an industrial type turbine in situ, are you suggesting that you would never have to carry such a heavy load such as would require a Hercules in order to effect repairs on a generator such as that? On a compressor station such as that, I am sorry?

A I think we would not suggest, Mr. Hollingworth, that we would never use a Hercules to carry material in to the nearest 6,000 foot airstrip. From that point the equipment if it was something as small as the hot blade path, probably could be carried by that type E helicopter and certainly could be moved overland.

Q My studies of this map system of yours tends to show me that you have one 6,000 foot runway between the Alaska-Yukon border and the vicinity of INuvik, is that correct?

A I would have to check to be sure.

Q So you would have difficulty using a Hercules to any great extent along that north slope, wouldn't you, there is just one runway capable of accomodating it.

A You can only land where there are strips that long, that is true.

Q Besides the 6,000 foot runways you will require other airstrips and I presume you are going to maintain and carry on with the ones proposed for the construction period?

A That is correct.

Q Are you planning to close

any of these strips down that you used during construction? Or will all these be required to the operations and maintenance of the line?

A There are no airstrips that I am aware of which would be constructed for the construction program and abandoned after that.

Q These strips are going to be gravel, aren't they, Mr. Hurd?

A Generally, except for places like Inuvik where the existing airstrip is asphalt and Norman Wells, also.

Q But apart from the established Department of Transport airports, you are planning to construct your own and they will be of gravel?

A Yes.

Q And you are going to maintain those, obviously, in order to have landings and take offs throughout the lifetime of the pipeline?

A Yes.

Q That is going to require quite a bit of gravel, I would think.

A "Quite a bit" is a relative term; an adequate amount of gravel.

Q Have you made calculations as to whether borrow is available to carry out these repairs over the life span of the pipeline?

A To carry out repairs?

Q Repairs to the airstrips, maintenance of the airstrips.

A We have made calculations, Mr. Hollingworth, to satisfy ourselves that there is more than adequate gravel to construct the airstrips and station pads and all other things that require gravel. The amount of gravel required to maintain the strips is a very small fraction of the amount required to build them. We propose to have stockpiles of gravel at airstrips and other locations where we can foresee the possible need for gravel. That amount required for maintenance would be very small.

Q Have you made calculations as to how much would be required?

A I have not made any calculations of that sort.

Q And do you know if the amount required for maintenance over the life span of the pipeline is included in the borrow requirement figures we have previously been given?

A I doubt, Mr. Hollingworth, that it was included as a specific item again, because the amount required for maintenance is very small compared with the total amount required to do the construction in the first place.

Q Has the applicant made any decision on what type of air cushion vehicle it will maintain in Inuvik?

WITNESS FIELDER:

A No, sir, we have not.

Q Are you considering from a few certain types or is there a broad range available

to you?

A There is a range available to us, Mr. Hollingworth, from the 24 ton Voyageur that I described last week, which is self-propelled, through the 100 ton non-self-propelled air cushion raft. In addition to that, a great deal of work is being carried on at the moment to develop the technology of air cushion vehicles even beyond where it is today and I understand that there is 225 ton vehicle currently being used in the MIddle East, so should we decide that we need something that big, it is available to us.

Q You say that the 100 ton model that you're looking at is non-propelled. What is the largest self-propelled model you're looking at?

A The largest self-propelled that I am aware of is the Voyageur, sir, which would carry 24 tons.

Q Wouldn't you need a self-propelled A.C.V. to be of any use to you?

A No sir, you propell it by some other means, like well for example it could be towed by another air cushioned vehicle, should it be decided to do so.

Q Well then you'd have --

A More likely it would be towed by an L.G.P. type vehicle.

Q Well, the statement is made in the application, is it not, that the A.C.V. will be useful over river and spring breakup conditions?

A I'm not sure if that's the wording, but I'll accept it if you say it is, sir.

Q I'm referring you to page 11 of the application, Mr. Fielder. It says about three-quarters of the way down:

> "An air cushioned vehicle which the applicant intends to have based at Inuvik to transport equipment and materials across water bodies during flooding and ice flow conditions."

A Yes sir, I see that.

Q So you couldn't very well tow it with a low ground pressure vehicle, could you?

A No sir, that couldn't be towed by a low ground pressure vehicle across the water, certainly not.

Q So you'd need a self-propelled one to be of any use to you in those conditions, wouldn't you?

A You would need a self-propelled one, certainly, to get across water during the time that ice was flowing down the river. You could also use the air cushioned vehicle, however, to get to the bank and then use helicopter to get across the bank -- across the river to the other side, and then be met with L.G.P. vehicles on the other side.You recall that we have a selection of equipment such as this at each and every compressor station.

Q A selection of low ground pressure vehicles, do you mean?

A Yes sir.

Q Now if this air cushioned vehicle is based in Inuvik, where do you envisage it being used mostly?

A Generally in the delta area and across the Yukon North Slope.

Q And there are severe ice conditions appear on the shore along the North Slope at certain times of the year, large mounds of ice building up on the shoreline, is that not correct?

A I believe that's right,

sir.

Q Now, taking as an example this 24-ton self-propelled machine that you've described, how large an obstacle can it overcome when it's travelling across the distance?

A I can't answer that precisely, sir, but if you'll accept a guess I'd say probably three feet in height.

Q Well, how high are the skirts on this machine?

A Sir, I just don't know.

Q Well, would you accept the fact that a Hovercraft has between its skirts and the surface crossing a small space which is called a Hover gap?

A Yes sir.

Q And that that Hover gap can't be too great or else the machine simply doesn't work and won't propell itself off the surface; isn't that not right?

A That's quite correct, sir.

Q Now, have you looked into the question whether it would cross a three-foot obstacle or not?

A Are you referring to the self-propelled machine, sir?

Q Yes, I am.

A No, I have not.

Q So you don't know for a

fact that it will cross such an obstacle.

A Not the self-propelled machine, sir. I do know that the raft that is made by Hoverjack can be constructed, and I was told this specifically by their chief engineer, to lift itself six feet off the water or off the ground surface.

Q Is that six feet the distance from the bottom of the skirts to the surface that's being crossed, or the distance from the base of the machine to the surface that's being crossed?

A From the base of the machine to the surface that's being crossed. You should know, though, sir, that the Hoverjack does not use a balloon type skirt such as the Arctic Systems air cushioned vehicle does, that is a 100-ton one, and hence ice flows, for example, or logs could hit the skirt and just pass underneath.

Q Well, what type of skirt or device does it use to achieve its lift?

A It's much like a loose drape. I don't know how else to describe it. It's just a thin material with a loose drape.

Q You mean it's a single sheet of material draping down?

A Yes sir.

Q Whereas a typical one is more like an inner tube attached to the machine, is that right?

A Not the typical one, sir. A different one. As I understand it, there are two

concepts that have been put forward in the design of air cushioned vehicles. One by the British and the other by the French, and I believe it's the British design that utilizes the balloon type skirt, the French one uses the other type. Both are currently in use.

Q But the British one is more heavily developed than the French one at this time, isn't it, Mr. Fielder?

A I couldn't say that, sir.

Q Well now, taking again this 24-ton -- did you call it a Voyageur?

A Yes sir.

Q What type of a gradient can it climb? Or can it climb any gradient?

A According to the specification sheet, about eight degrees.

Q And are there slopes greater than eight degrees along the North Slope route proposed by the applicant?

A There may well be.

Q You don't know?

A Once gain I'd have to get specific, because one could run down the river valleys to the point where you could get out of the river valley and then come back onto the right-of-way, for example. In other words, it's not necessary to follow the steep slopes, you can pick and choose your way.

Q Well, suppose you wanted

to get to a rupture some point between rivers on the North Slope. Wouldn't it sometimes be necessary to go up a gradient on the right-of-way to get to that point if you're using the air cushioned vehicle?

A Very likely.

Q And if that slope was greater than eight degrees, are you now saying that you couldn't reach it?

A No sir. I'm saying that you would get up that slope in a different manner, either you would find a shallower slope to get up, or you would start an L.G.P. type vehicle out from the compressor station on the other side of that break to meet the air cushioned vehicle, and when it got to that steeper slope it could be winched up the slope by the L.G.P. vehicle and carry on its way. In other words it can be helped by other means.

Q Of course, all this is taking some time.

A Yes sir.

Q Now, assuming again this break on the North Slope, if the A.C.V. was called into action from Inuvik, which way would it take to get to the North Slope? Would it go out over the Beaufort Sea?

A It would depend upon the time of year. Certainly if it was water, I suspect it would. If it was frozen --

Q Suppose it was ice.

A -- it would have to pick

and choose its route.

Q Over the Beaufort Sea?

A Yes sir, providing that it could make it. I just don't -- assuming that you have no more than three-foot high ice , for example, it could probably make it. If you had six-foot ice, it probably would not. You'd have to take a different route, perhaps down one of the branches of the Mackenzie River, and then follow the right-of-way. It would depend where you're talking about, where the break occurred, where the air cushioned vehicle was at the time the break occurred, and what other vehicles were available to help it on its way.

Q But if it went down the Mackenzie River to the right-of-way it would at some point have to leave the river and get over to the right-of-way.

A Yes sir.

Q And again you might run into this problem with gradients, or you might run into trees, you might run into any number of obstacles.

A That's quite correct, but once again it could be towed.

Q What I'm suggesting to you is that this air cushioned vehicle could not be relied upon to be of any use whatever in the event of some mishap occurring along the North Slope.

A I disagree, sir.

Q Well, we've gone through some of the obstacles it might face. Do you not

agree with me there could be instances when it simply wasn't usable because it couldn't reach the site?

A I'll agree with you that such a circumstance could occur, but I don't believe that you've described it this afternoon, sir.

Q Well, would you describe the circumstance when it could occur, then, Mr. Fielder?

A Only, I believe, if the ice conditions in the Beaufort Sea and the rivers were such that it was impossible to pull anything that required less than six feet of clearance. I don't know that that condition ever occurs at one time everywhere. Even if that were the case, then of course one would during those times fall back on the other types of equipment that we have available to us. You could use the air cushioned vehicle, whenever it's practical to do so. As is the case with all of these vehicles, they have a particular application, and one chooses the circumstances under which one would use them.

I described last week, for example, that a rologon could carry 30 tons. Start out three rologons and have essentially the same load as one air cushioned vehicle, over ice.

Q O.K., well on page 14 then, the last paragraph, there is a discussion of line patrols by fixed wing aircraft, and it's stated that fixed wing aircraft would be used on flat country and rolling country, is that right, Mr.

Hurd?

WITNESS HURD: That's correct, yes.

Q And otherwise you would have to use helicopters.

A Helicopters are another option, yes.

Q Are there further options as well?

A For line patrol, depending on the time of year you could use all terrain vehicles; in the wintertime certainly personnel carriers that can go along the surface and in the wintertime without risk of damage to the surface terrain. There will be occasions, I can imagine, where on the ground foot patrols would be done.

Q And in summer?

A In summer generally aircraft would be very much the preferred method because it keeps the patrolling people off the ground altogether.

Q Well, if you had to accept the interior route rather than the coastal route coming from Prudhoe Bay, what type of country does that cross?

A It's more mountainous, even in the Canadian portion, than the coastal route is. They are not large and rugged mountains like the Alaska section of the interior route. It's rolling, some areas are flat near the Old Crow Flats it's quite

gently rolling and flat.

Q Well, would you be able to use fixed wing aircraft along the interior route?

A Yes sir.

Q The entire way?

A Yes sir.

Q Well, if that country is suitable for fixed wing aircraft, where are the areas where helicopters would have to be used?

A There are no areas that I am aware of where helicopters would have to be used. Fixed wing aircraft, small light fixed wing aircraft is usable along the whole of the system.

Q I was just wondering, further up that page it says, "Where the use for the fixed winged aircraft for line patrol is not practical, helicopters will be used on line patrol." Where, geographically, are those areas going to be?

A There may be areas in particular -- in particularly mountainous terrain where a helicopter would be more desirable perhaps, in a particular situation, weather situation, than the fixed winged aircraft. The helicopters are more desirable in situations where you might wish to drop down to the ground so that people can walk around and inspect it more closely. But given reasonable weather conditions, the fixed wing aircraft can cover the whole of the pipeline.

Q So the meaning of that statement isn't with reference to geographical areas, it is with reference to flying conditions and the desire to get down closer to the ground, is that more correct?

A That would be the advantages that a helicopter has over the fixed wing, yes, sir.

MR. HOLLINGWORTH: Okay, thanks, gentlemen.

CROSS-EXAMINATION BY MR. TEMPLETON:

Q If I ask my questions now it will guarantee that they will be finished with me in short order.

In your statistical summary

regarding ruptures, which I believe was in the answer to question 22 of the PAAG report on off-road vehicle traffic required for contingency repairs and I think that you worked out the breaks and the frequency of ten and a half years for a break. And then later on on page 22-19 you state at the top of the page,

"The applicant refers to its response to sub-section one of question 22 in which it determined the frequency of the need to make major pipeline repairs is very low, i.e., statistically it is perhaps once in twenty years."

Continuing the quotation:

"Where a major repair is necessary, the probability of it occurring at a location and during a season in which critical and environmental sensitivities will be a serious consideration is of course very much lower."

I was wondering -- I am not questioning the difference between whether the frequency is ten and a half or 22, it is the statistics in which the -- were made and do they apply to maturely operating pipelines, is that the whole industry of the United States or of Canada? Is this a United States and Canada figure?

A Mr. Templeton, we quoted both. The United States statistics were compiled by the Battele Institute and are contained in a report prepared for the American Gas Association dated May of 1973

entitled, "Reportable Incidents for Natural Gas Transmission and Gathering Lines, 1970 through 1972". that is the one that resulted in a statistical probability for breaks north of 60 on this system of some one every ten and a half years. The Canadian statistics were gathered from three major gas transmission companies operating in Canada and operating between them a total of some 7,000 miles of 30" to 42" diameter pipeline over a period of about 17 years.

Q But do the statistics refer to the -- all of the pipeline -- in other words, when do the statistics start when the pipeline is put in operation?

A I am not sure, Mr. Templeton, that I understand the question. That last part seemed to be the answer.

Q Well, when is the break in period? You build the line, you test it, and breaks occur -- otherwise you wouldn't test it, and so then you -- somewhere in that period, comes the time when you say, now I am on operation. Is that the time when the statistics are started to compile?

A Now I understand. U.S. statistics covered the years 1970 through 1972 and covered some -- an average over those years of some 12,800 and some odd miles of pipeline. I am sure that the great bulk of that pipeline was constructed before the period that was examined. Therefore it was a period selected after those pipelines had been in operation in some cases for some time and in other cases

for shorter periods of time. The Canadian statistics are reported over a period of some 17 years and I can't be certain without checking,my understanding of that would be that statistics began to be collected after the pipeline went into operation.

Q So that there is a period, perhaps before this work-in period where there can be line breaks considerably in excess of this that would not affect the statistics.

A Not a work-in period after the line went into operation, Mr. Templeton, the testing program, if it resulted in breaks, would not be included in these statistics.

Q Well, I think in the April '73 interdisciplinary meeting that you have quoted a number of times and which I believe is exhibit 85. There was quite an exchange between Mr. Morden who was then the operation and maintenance man and Mr. Walker who is the construction man and I realize that both of them have gone now, but,as to when the break-in period was and my understanding of that time was that they were going to have two years called the construction period, and is that still the condition?

A There is a two year period, approximately two year period, during which separate sections of the pipeline system are constructed and at the end of which the total pipeline system goes into operation from the Richard's Island area.

Q Well, I think what I am

getting at is that this is a period when there is much greater risk of land breaks and there probably will be for sometime thereafter and that this would not be reflected in the statistics that were presented.

A Those land breaks, Mr. Templeton, are breaks that might occur, if any do, during the testing program and the testing is done hydrostatically and is a very different phenomena than the line break on an operating pipeline that is filled with gas.

Q Yes, but if -- I am interested in the environmental aspects and it does not really matter why the line breaks or how it breaks, you have to repair it regardless of whether it has gas in it or a fluid.

A I understand, -- the difference perhaps is that during the testing program which is a part of the construction program, equipment for making repairs is right there and the testing and the repair would be done during the construction season.

Q Well, I wonder if that is always the case or if you are working at a very compressed schedule, in the winter time and you have a close off date where your entire operation is working towards, we will say March the 30th, when everything must shut down, I am not sure that all of those operations can necessarily be programmed to coincide with a shut down date of one particular day and say under no circumstances will we ever repair a line break after March the 30th, can you say that?

A I think all we can say, Mr. Templeton, is that the construction program we were listening to -- this panel was listening carefully to the evidence given by that panel -- construction program includes a safety factor built into it to take account of any of the causes of delay so that work after the safe construction period can be avoided. One of those causes might be a line break during test that occurs towards the end of the construction season.

Q I hope you don't have the optimism of Mr. Drapeau. Mr. Carlson, do you remember how many line breaks there were in testing of the original Trans-Canada Pipeline?

WITNESS CARLSON: Yes sir. I believe it was 18, 17 of which were the result of cracks that occurred in the pipe during rail shipment. This phenomenon was somewhat new to our industry,since about 1962 Trans-Canada has used the Bechtel organization to design and the packaging of up to 80-foot lengths of pipe for railroad shipment. These cracks were in the order of three to four inches in length, and we had some spectacular failures during testing the original line.

Q Yes, it was spectacular because you were testing with gas, natural gas rather than --

A That's right.

Q This one will not have the spectacular things, but breaks do occur ?

A I would submit this one will not have that type of defect built into the pipe.

Q No, I suspect that -- but then there are different conditions such as much greater wall thicknesses and brittle fracture or lack of ductility due to the very cold temperatures, and probably there are different situations and that there can be breaks in this line, too.

A I would submit, Mr. Templeton, that most of the breaks that have appeared in statistics that have been published, occurred in what we would refer to as first generation pipeline steels. I know in Trans-Canada's experience since about 1967, and this covers several hundreds of miles, I am sure well over 1,000, possibly 2,000 miles of loop line, Trans-Canada has not had a rupture during field testing of new pipelines built with present-day technology steels.

Q Yes, but/did Trans-Canada put in this sort of mileage in the wintertime? A great deal of that went in the summertime, didn't it?

A A great deal, I would say about 50-50. We start, launched into a winter construction program in 1971, and I think we had close to 1,000 miles of pipeline built in the winter since that time.

Q But not with this wall thickness. Right?

A No sir.

Q And the brittle fracture

or lack of ductility of pipe is related to the greater the wall thickness, the greater the problems of lack of ductility, right?

A Well, present-day specifications spell out a ductility which is much superior to the original pipeline steels that went into older pipeline systems.

Q Oh yes, I realize that.

A And the phenomenon of brittle failure is one we have not experienced for many years in new pipeline steels, during test.

Q To get back to statistics, the statistics apply to our projection from known occurrences; is this right?

A That's correct.

Q But there have not been in Canada or the United States these conditions under which to build pipelines. Is that right? I'm talking now about frost heave , permafrost, chilled pipelines, large diameters, thick wall thicknesses, so I'm having a little difficulty projecting the statistics of Canada and United States in the existing pipelines into north of 60.

WITNESS HURD: Many of the conditions, Mr. Templeton, are beneficial when making the projection into Arctic conditions. The Arctic is not all bad news. Well, two good examples, firstly the major cause of pipeline breaks in operating pipeline are causes by outside forces or damage caused by third parties working near or on the pipeline. Perhaps about

50% of all operating pipeline breaks result from that cause. The population density, industrial activity and other activity in the Arctic is very much less, of course, than it is in southern regions, and that cause will be very much less in the Arctic.

Another example is that a significant cause of pipeline breaks is corrosion that occurs, historically has been corrosion that has occurred on the pipeline. Again the Arctic environment is much more condusive to a safe pipeline since corrosion is much less likely to occur.

Q Well then, let's tackle frost heave.

A Frost heave is unique to the Arctic and has received a lot of careful study by the group, we are satisfied, confident now that we predict areas in which frost heave will occur, that we can minimize the chance of it occurring to any extent that is harmful, and that in areas where the risk is marginal and protective measures probably are not required, the pipeline can be monitored during its operating years. One thing about frost heave is it occurs very slowly and there is opportunity to detect it and take corrective measures if it happens.

Q Yes, I accept that; but I keep coming back to the problems encountered when you're correcting these things. Now, I think Mr. Fielder explained previously how the problem of going around to a circuitous route so that he would avoid the six-foot obstruction, and these are all probably

necessary to repair that break, but a lot of those things leave some terrain degradation of one kind or another, or a mark, and I wonder if you've considered what this does? Do you consider the value of land in its natural state as a component of the environment that which has to --on which you have to spell out impact, or to demonstrate impact?

A Was that a question, Mr. Templeton?

Q Yes. It was meant to be, I don't know whether it turned out that way. Do you consider -- sorry.

A We would certainly not like to leave the impression that the pipeline can be operated without ever making a track on the Arctic terrain. I think what we do say is we can minimize damage to the Arctic terrain, using the type of equipment that Mr. Fielder described, and at the same time make the repairs that are necessary. We would say also that whatever damage is caused can be repaired, using methods that are proposed for the construction of the pipeline, and that the damage that is likely to be caused by operating procedures is very much less than what would be caused by trenching, and which can be repaired by re-vegetation and other methods.

Q Well, to get back to that re-vegetation, I think you say on page 22-7 of question 22 of the PAAG report, I'm not sure I can quote the whole thing, but I think you refer to re-vegetation to restore ground cover. Do you mean that you can

restore the vegetation, or restore vegetation, or do you mean restore the terrain? In other words you're saying, "I can grow some perhaps grass in this, and that restores the vegetation." But does it restore the thermal balance?

A We think, Mr. Templeton, that the thermal balance can be maintained by protecting the areas where the natural vegetation has been removed, in some cases with a temporary cover which might be an organic material held down with wire netting, or plastic netting; and that re-vegetation can proceed and that ultimately the re-vegetation will provide the protection -- thermal protection that is necessary.

Q What will you consider "ultimately?" How many years?

A Quite quickly protection would be provided by the grasses that would be seeded with fertilizers which would grow quickly. We think that over a period of many years the natural vegetation would encroach upon those imported grasses and that the natural vegetation would prevail.

Q Yes, but I think there's a difference between restoring vegetation and restoring thermal balance. All the reports, I think including yours, would indicate that the restoration of a thermal balance in an area where the peat mat had been disturbed or taken off is in much -- I think there's perhaps a little difference of opinion on the number of years but certainly it's not in ten years. I'm not talking about physical erosion; I'm talking about thermal

balance.

A Thermal balance has significance, I think, only where a change in thermal balance would cause a regression of the permafrost which in turn might result in erosion. So the object --

Q This goes back to the other question, though: Do you consider the preservation of land in its natural state part of your impact?

A Consider that we have an obligation to preserve the land in as near as possible, and practical, in its natural state, yes, sir.

Q But Mr. Fielder is going to wander around with his -- and I realize that he is not going to tear up the -- all the tundra with his low pressure vehicles, but these do leave marks and I think that you would agree, would you not, that the marks around Prudhoe Bay and the hillsides are objectionable. I realize that Mr. Fielder is not going to make that kind of mark as those are now five, six feet deep, but he will leave marks, will he not?

A If by marks, Mr. Templeton, you mean tracks that can be seen, that is very possible, that at certain times of the year tracks will be left that can be seen. That is not necessarily followed by a change in the thermal regime and permafrost degradation and erosion and all those terrible things.

MR. FIELDER:

A If I can interject, most of my wandering around was being done on the ice, Mr. Templeton, just a little bit on land.

Q Well, I am not sure it was now, I think you were going to try and get as close as you could to that site, but then you were going to bring another vehicle in.

I think there are obstructions over six feet, I just don't know anywhere in the north where there aren't so I assume that you have to go around quite a few things and I think that the point is

that some of these things regarding maintenance do occur outside the right-of-way, and that there are other things to consider the impact rather than just the 120-foot strip and that your operations and maintenance do extend beyond that. I think that there seems to be a tendency perhaps to forget that.

THE COMMISSIONER: Mr. Templeton, what were the marks that you refer to at Prudhoe Bay, they were obviously more than marks, what caused them?

MR. TEMPLETON: These were caused by bulldozers and I think that there is one famous one where a bulldozer operator decided to indicate to a friend where he was going and so he left -- made an arrowhead by making tracks on the tundra and that mark today has gone down, I think about six feet, because he disturbed the tundra, disturbed the insulating mat, and then the mat started to melt and it is not stopped -- that was done -- I have forgotten how many years ago, but perhaps, five, six, seven years ago, it is down six feet today and I do not think anybody has predicted where that stops. Obviously it will somewhere, but it is a slow process. Now, I am not trying to compare what Mr. Fielder is doing with a low pressure vehicle with that Cat track, but, even if it were a depression of a foot, which, perhaps, he might argue is too much too, it wouldbe offensive to a great many people as a -- from esthetic value and if there were vehicles of some kind that disturb it, of course then you would get a trench and this is only in the areas of high ice content.

I think that is all I have,

Mr. Chairman.

THE COMMISSIONER: We will take a brief adjourment now then.

(PROCEEDINGS ADJOURNED)

(PROCEEDINGS RESUMED PURSUANT TO ADJOURNMENT)

CROSS-EXAMINATION BY MR. LUCAS:

Q Mr. Hurd, in your operations and maintenance plan have you made specific provision for environmental surveillance and monitoring by the relevant government agencies? Have you taken that into account?

WITNESS HURD:

A Not in a specific way, Mr. Lucas. We recognize that there are authorities who are concerned with that and have been in the past and we expect that they will continue.

Q You realize, do you, that off right-of-way vehicular movement will be governed to a large degree by land use permits under the territorial land use regulations?

A We are aware of those regulations, yes sir.

Q And have you taken that into account? In terms of dealing with line break contingencies?

A We recognize that, for example, the construction of what Mr. Dau referred to as -- or as Mr. Williams referred to as a shoo-fly road, that sort of thing would require authorization from the responsible authority.

Q I am referring specifically, Mr. Hurd, to the movement off right-of-way of heavy vehicles, whether on a prepared road surface or not. Have you taken into account the fact that permits may be required for that sort of activity?

A Yes, sir.

Q And have you built that into your contingency plans?

A We are aware of it, Mr. Lucas. There is nothing I can think of at the moment that requires building into the plan. The plan includes obtaining all of the authorizations that are necessary to allow us to travel where it is necessary.

Q Could you refer, Mr. Hurd, to page 31 of section 13 B.

This is under the head,"Implementation of Contingency Plan", and the passage that I am referring to is in the second paragraph on page 31 under the heading, "Reporting". The section describes how a line break contingency would be dealt with and then in the second paragraph on page 31 it is stated, quote:

> "When the line repair is completed and the pipeline is returned to normal operation, the District Superintendent will prepare a comprehensive report for submission to the applicant's management and relevant government agencies."

Now, Mr. Hurd, does this mean that it is not contemplated in your operations and maintenance plan that

relevant government agencies would be advised of the occurance of line breaks until they had been taken care of?

A No, sir.

Q When would they be advised?

A As early as it is reasonably practical to do so.

Q Could you explain that, please?

A As soon -- if a line break occurred,as soon as the operating company was aware of the break, then government agencies who would be concerned would be advised.

Q Okay, so the relevant governmental agencies would be advised immediately upon the discovery of a line break?

A Yes, sir.

Q Mr. Hurd, just carrying this one step further. In dealing with line break contingencies, would the resulting documentation and reports prepared following a line break be available to the general public? Could the public get copies of this material?

A I don't know, Mr. Lucas, whether they could be immediately available through the company. There are regulations requiring that reporting on land breaks, including the causes and methods of repair and timing be made to the National Energy Board and there is a requirement of that Board also that the Board be notified immediately on the

occurance of a break. Whether the Board might have some influence on whether the report was made available to the public generally, I don't know. I can think of no reason why the operating company would try to withhold it.

Q Well, Mr. Hurd, as a matter of Arctic Gas policy, would these materials be made available to the public?

A Mr. Lucas, I am not sure that I can speak as a policy witness. I hesitate a little bit because there may be situations where initially it might be suspected that the cause of the break for example was a flaw in the pipe and which might cause the company to want to go and talk with the supplier of the pipe and that -- those discussions could be jeopardized if the details of the metalurgy was made public. I just do not know.

Q So the company has not developed a policy on this yet?

MR. MARSHALL: Well, Mr. Lucas, we have made it clear that a policy witness will be called and as Mr. Hurd has indicated to you, he does not really feel that he can speak as a policy witness in these areas, but perhaps you might wish to put that same question to Mr. Horte.

THE COMMISSIONER: Mr. Lucas, why don't you put that question to Mr. HOrte. If he says, "We haven't developed a policy", or if he says, "We have developed a policy and this is our policy", in either event, it seems to me that subject

to what other counsel might say in due course you are entitled when we reach the stage of making submissions, to argue that the Inquiry ought to recommend that the report be made public or not made public or sometimes made public and at other times not made public, as you wish, but there is not much point in pursuing it with Mr. Hurd, is there?

MR. LUCAS: Well, perhaps I can get this clear. These gentlemen are employees of Canadian Arctic Gas, is that correct?

A That is correct.

Q But notwithstanding that fact, this panel will not speak to policy matters, is that correct?

MR. MARSHALL:: Well, I think you can ask him whether or not a policy has been developed on this specific point and if so he will speak to that question, but if you get into the area of will the company establish a policy to do thus and so it seems to me you have to speak to management of the comapany.

THE COMMISSIONER: I think that is sound. I do not really see how you can expect Mr. Hurd to make up company policy as he goes along if it hasn't been developed yet.

MR. LUCAS: I guess I wanted to clarify the situation regarding Mr. HOrte and these witnesses since they are all officials of the applicant, Canadian Arctic Gas. I think I have the breakdown clear.

THE COMMISSIONER: I do not know

if they are -- I do not want to pretend that I do not know anything about it but they are not officers of the company -- I do not think that they are.

MR. LUCAS:

Q Are you, Mr. Hurd?

A No.

MR. SCOTT: Mr. Commissioner, just one point at this time I am glad to hear Mr. Marshall say that Mr. Horte will be able to answer questions of this type because I was rather concerned by something said last week that Mr. Horte wouldbe able to answer only very generally about policy matters and would not be able to give detailed analysis of policy decisions, but I understand now from Mr. Marshall that at least he will be able to answer questions of this kind of particularity.

MR. MARSHALL: I think you were not listening to my remarks, Mr. Scott, I said that Mr. Lucas might wish to ask Mr. Horte what the company's policy was. Frankly, I don't know, I cannot say what Mr. Horte's answer to that question would be.

MR. SCOTT: I am afraid I was listening.

MR. LUCAS: Can I ask a question?

Q Okay,just one more question along the same line, Mr. Hurd, and perhaps this matter will have to be taken up with Mr. Horte as well. The question is, have you considered and taken into account in developing the operations and

maintenance plan, the possibility of co-operating with an independent environmental monitoring group and what I have in mind is the Arctic Environmental Counsel, the group that has been established in Alaska under the auspices of the Arctic Institute of North America to monitor construction of the Tans-Alaska Pipeline. Have you taken that possibility into account?

A Are you asking, Mr. Lucas, about the environmental monitoring during construction?

Q Yes, and during operations of the pipeline as well.

MR. MARSHALL: I think it goes without saying--

Q You could speak to the latter, presumably.

A We have not considered an independent environmental monitoring organization in the sense that there would be some sort of formal arrangement made with that independent group. We can imagine that there will be a variety of independent groups each of which will have information on the environment and that will be one of the many sources that our own environmental people would go to find out information about, for example, the current state of the caribou migration and other things that will be useful for the operating people to know about. I guess we would include ourselves as a source of considerable information on changing environmental situations.

THE COMMISSIONER: Mr. Lucas, do you say that in Alaska the Alyeska Company has been required as a matter of law, or has decided as a matter of policy, to make certain material available to the Arctic Environmental Council, which I take it is a public interest group in the sense that it is not -- it has no Statutory powers?

MR. LUCAS: Yes. My understanding, sir, that it has decided to do this as a matter of policy, and that's a question that we'll be putting to Mr. Horte. Have you got that, Mr. Marshall?

MR. MARSHALL: I get a copy of the transcript.

MR. LUCAS: Q Mr. Hurd, turning to page 3 of Section 13 B, in the second paragraph it is stated, and I quote:

> "As the operational stage approaches, a detailed operations and maintenance procedures manual will be developed and issued for reference and observance by operating personnel."

Now, this detailed operations and maintenance procedures manual, will the manual include details of procedures to be adopted to minimize environmental damage by various operations and maintenance activity?

A Yes sir.

Q And are you in a position to say what subjects will be covered?

A I might give some examples, Mr. Lucas. Whether that would be a very complete rundown is another question. For example, the caribou --

Porcupine caribou herd migration moves from North-Central Yukon northward toward the coast and through areas where the coastal route of the pipeline would be, turns from there and goes west, calves in the area along the coastal plains, and migrates from there further west and then sort of mills around in that area. There are times when disturbance to the herd would be serious. At the same time, there will be a need to patrol the pipeline. One of the things that the operating people who are patrolling the pipeline would be required to do would be to be aware of where the caribou are, and what they must do to avoid disturbance to the herds, especially during calving periods.

Another example would be means by which they can minimize damage to the terrain when ground travel is necessary, and methods for repairing any damage that might occur to the terrain. Probably the staging and moulting of migratory birds along the North Coast is another example that the operating people would need to be aware of, and this manual would describe the staging activities and what must be done to avoid undue disturbance to them.

Q Now, what is the schedule for completion of this manual? Will it be completed prior to regulatory approval?

A No sir.

Q Mr. Hurd, at page 18 of Section 13 B, it is indicated that:

"Personnel will be thoroughly trained and familiarized with all operational procedures

and with pipeline equipment, and that a written startup procedure will be prepared and provided to personnel for each facility." Now, is this part of the operations and maintenance manual that was referred to?

A The startup procedure, Mr. Lucas, perhaps might be called a separable part. It's written for that single purpose of starting up the pipeline. There would be startup procedures manual sections for each compressor station, once the pipeline or a particular station is started that manual -- for the pipeline the manual is no longer required after that. There would be a new startup procedures manual for each new station as it's brought on the line.

Q And will environment protection measures be written into the startup procedures?

A Yes sir.

Q But at this stage you can't say precisely what they will be.

A No. The manual itself can't be written until a lot of other information is available, for example, the details of the design of facilities is necessary before the manual can be written.

Q So this won't be until after regulatory approvals?

A That's correct.

Q That is the writing of

the manual won't even start until following regulatory approvals?

A Oh, I'm sure that considerable of the work is available now which will go into the operations manual, so I would have to say that it probably has started now. It will be an evolving thing and finally completed only when we know the details of the design of the system.

Q Mr. Hurd, in response to Mr. Hollingworth, I believe you indicated that turbine engines will be used at least fairly extensively in driving the compressor stations.

A Yes.

Q In the cooling and lubrication of these turbine engines, will synthetic lubricants such as Imol S-140 be used?

A The present plan is to use the synthetic lubricants only in the turbine end, the gas generator end of the equipment, not in the reaction turbine, nor in the compressor. Mr. Lucas, this subject can be dealt with much better by Mr. Carlson. I wonder if I might defer that question to him?

Q All right, Mr. Carlson, have your environmental advisors told you about the potential toxic qualities of these synthetic lubricants?

WITNESS CARLSON: I have not experienced any information of that type, although my previous company did use synthetic lubricants exclusively. We recognize that certainly there is

a toxic problem with synthetic lubricants.

Q How are these substances going to be stored on the compressor station sites?

WTTNESS HURD: There will be lubricant storage facilities -- the lubricant storage facilities are described in Section 8 B of -- generally they are steel tanks that -- for which in the case of -- steel tanks that are reliable containers and not subject to leakage. We recognize the hazards of synthetic lubricants.

Q Well, have you developed any special contingency procedures to deal with the event of spillage or leakage of these substances?

A We have discussed procedures for recovering spills which are fairly straighforward if it's a very large volume of material and I should emphasize that the synthetic lubricants are required in very small quantities at a station, and there would be no need to have large volumes of them on hand. So that spills of the synthetic lubricants on the station site would not likely be a difficult thing to deal with at all.

Q So you're not taking any special measures in their storage?

A I'd have to say yes that we are, we are taking precautions to be sure that the tanks that they are stored in are reliable and not subject to leaking easily. They would be handled carefully.

Q That's no different than what you're doing in the case of the storage of petroleum substances, oil and gasoline and so on.

A We're handling those materials carefully also, yes.

Q Mr. Hurd, I'd like to refer you to question 22 in the responses to the Pipeline Application Assessment Group.

THE COMMISSIONER: While you're finding that, Mr. Hurd, and Mr. Lucas, could I just interrupt and ask Mr. Fielder one or two questions to make sure what I understand what you said earlier, Mr. Fielder, about the Russian natural gas pipeline systems that you observed.

Q You can sit down for a minute, if you like, Mr Lucas. This might take me a moment or two.

You said that there were three systems, first was the Yakutsk system. The first gas pipeline system the Russians built in the Arctic, and that according to your map, is in the region of Siberia called Yakutskaya and that is in what I suppose is Eastern Siberia?

WITNESS FIELDER: That's correct, sir.

Q That Yakutsk line was laid above-ground on supports and it is what, 221 miles in length or 341?

A Sir, it's 256 miles in length, in total length, plus additions between Taas-Tumus and Pokrovsk and about -- excuse me, 221 miles in length.

Q 221, yes, I follow you.

A And about 120 of those miles are above ground on supports.

Q Well, what about the other 101 miles, was that buried or what?

A Sir, I just don't know. What you see in front of you there between the quotation marks was the only passage I could find in every report that I was able to dig into that dealt with that system.

Q Now, you say -- or the report says, I don't mean what you say but you say that it has been a useful testing ground for construction techniques in permafrost, and that quotation is from the American Gas Association Report. Do you know anything more about it than that?

A Sir, I assume that what they meant, because this was the A.G.A. spent quite a lot of time looking at the Messoyakha and Norilsk line, and didn't visit the Yakutsk system. They quoted only what they were told by the Russians at that time, which was 1970, and I presume that what they meant was that after having built that line in the

vicinity of Yakutsk, the Soviets made whatever changes were necessary to improve the design and construction in the Messoyakha-Norilsk line. But I'd like to emphasize that that's just my opinion.

Q Well, I'm only asking you these questions because you seem certainly to know more about what is going on there than anyone else in this room. Perhaps not, but at least more than anyone else that's given evidence with the possible exception of Dr. Hardy; but he's gone now back --

A That's right.

Q -- to Calgary, and the -- well that was the first Russian line, and that was in Eastern Siberia, and I take it that it was built in permafrost, though I'm not entirely clear whether you're certain of that.

A Yes, I'm quite certain of that. Drs. Hardy, Morgenstern and Slusarchuk were all there at one time during that Permafrost Conference in 1973, and commented that it was ice-rich permafrost country. You could see polygonal patterns on the ground and hence knew that there were ice wedges in that area.

Q All right, that was a 221-mile pipeline. Then you referred to the Messoyakha -Norilsk system which just looking at your diagram again is above the Arctic Circle and it is in Western Siberia and appears to be just east of that river that empties into the Arctic there. Do you know the name of that river or of that inlet?

A The large inlet is the Ob River basin, spelled O-B.

Q yes, and that one, in your evidence you don't say how long that line is, the Messoyakha-Norilsk line.

A Yes sir, it's 265 km. I didn't convert that to miles but I can do it quickly, if you like.

Q Well -- it would be about 160 miles, would it? You don't have to convert it.

A Just multiply it by .62 and that gives you your answer in miles, approximately, sir.

Q Now that one, according to you, has three major and 80 minor stream crossings. This line was started in '67 and completed in '68. If that was in fact built through permafrost it would presumably -- there would presumably be a great deal of Russian experience connected with that line that it would be helpful to us to know something about. You say here -- not you, but this report says that that pipeline is pile-mounted.

A Yes sir.

Q And --

A Except for river crossings, the major river crossings.

Q Yes. Given the fact that it is entirely above the Arctic Circle, I suppose the presumption is that it was built through permafrost. Is that your understanding?

A Yes sir, I'm positive of that. Dr. Taylor visited with this group in the fall of 1973, and at that time he was working with Arctic Gas and I discussed the system with him after his return. I didn't go into -- I didn't quote his report environmentally here because I wasn't sure that he would feel that he has the credentials to be considered an environmentalist, although the trip was certainly for that reason, that is to observe the after-effects of the construction of that line. Dr. Taylor's report does say something like the environmental after-affects are apparently very minimal. They saw nothing that indicated that there were serious problems even though the Soviets apparently designed and constructed the line with little concern for environmental matters. He pointed out in his report that their main concern was to make certain that they didn't interfere with caribou migrations, and hence periodically in the areas where they felt migration might be a problem, they increased the height of these lines above-ground to something like two meters instead of one, so the caribou could pass underneath it, and I believe they did mention that on occasion they buried the line or built it just barely below ground so that the caribou could go over it. This was just done for experimental purposes just to see how it would affect; and when I was in Russia we were shown a movie film of that particular system and the caribou coming up to it and passing under it and jumping over it and the like.

Q This was a Russian movie?

A Yes, it was.

Q All right, so there have been two pipelines, gas pipelines, one 221 miles in length, the other perhaps 160 miles in length, built in permafrost in Russia, and one in the mid-'60's and one in the late '60's, and both were built on piles. YOu said the second one was built on piles. The first one, the Yakutsk line, was laid above ground on supports, is that the same thing as building on piles?

A Yes sir. The Yakutsk line was built partly on piles and partly not, and once again I can only presume that when they decided not to use the piles it was probably because either they were in an area that didn't contain permafrost or they were in an area in which the permafrost contained very little excess ice and hence they anticipated few problems.

Q Now, if you had -- by "you" I mean Arctic Gas and Northern Engineering -- had opted to build on piles above ground, you wouldn't have had to face this question of chilling the gas so that when you buried the pipeline you wouldn't melt the permafrost. Do you know whether the Russians had considered that option, that is considered rejecting the notion of building above-ground on piles, burying the pipeline, and chilling the gas so as to protect the permafrost? Do you know if they considered that?

A No sir, I don't know that.

Q Then you referred to the third system which you actually saw yourself, the Medverzhye system in Northwestern Siberia, in what I take it is a series of enormous gas fields that dwarf even Prudhoe Bay.

A Yes sir.

Q But that one wasn't built in permafrost. They were at pains to avoid permafrost, I take it.

A Generally speaking it was not built in permafrost. Occasionally they had to cross patches of permafrost, but as I understand it it was well-drained, frozen sand and hence they were not concerned about thawing it, in other words a thawed, well-drained frozen sand was not assumed to cause any kind of a subsidence problem and indeed it has not.

Q They were not pressing through ice-rich soils?

A Quite correct.

Q So that the Russians faced the problem of logistics in these wilderness areas, they faced the problem of the cold and the darkness. In the Yakutsk system when they built that and in the Messoyakha-Norilsk system they faced the problem of the permafrost, but they decided to avoid it by simply building on piles above the permafrost, so that their solution they opted for was quite the opposite almost of the solution you opted for. Is that why you say at the end that there is not a great deal we can learn from their technology?

A Sir, I think that if we had decided for some reason or other to build our pipeline on piles, we would probably want to take advantage more of what we see in Alaska today than what the Russians have done, and I say this only because the reports that I read suggest that the Soviet pile system leaves something to be desired.

Q In terms of what -- you said

the environmental damage was minimal according to Dr. Taylor, what --

A Just the quality of the pile system themselves, -- many of them had to be replaced. I do not know for what reason and I hesitate to guess in an area such as that, but I gather that as they gained experience with the use of piles they improved their pile design and some of the earlier ones, the first line out of Messoyakha-Norilsk, for example, was described as being, I think, disastrous was the word, so I think we would be more inclined to utilize the technology that is available to us from Alyeska right now should we decide to go that route. The Russians certainly cannot help us when it comes to the chilled gas problem because they have not faced it and --

Q Well --

A -- are not.

Q Well, the Alyeska line cannot help you with the chilled gas because that is oil and it is being carried -- well, partly above ground and partly below ground as I understand it?

A That is correct.

Q And the permafrost areas in the Trans-Alaska line, there they are carrying oil above ground on piles only burying the pipe once they have gotten south of the permafrost zone. That is what they are doing, isn't it?

A If not that, burying it only when they can bury the line in ice free frozen

gravels.

Q So that you say the terms of the -- if you were considering the option of going to a pile supported pipeline, you would expect the technology being used by Alyeska in Alaska to be rather more useful to you than the technology of the Russians in the Yakutsk and Messoyakha-Norilsk lines?

A Yes, sir, the reason being that Alyeska has and are designing piles that are, that must be much more massive than what the Soviets have faced. The systems that I described to you -- the 28" line is the biggest one that was on it, I think a 20" and a 10" in the Yakutsk, so they have not faced the size of the pile, certainly, and particularly in areas like the Alaskan north slope, the terrain and the soil conditions are not a great deal different than what they are along our proposed coastal route of the Yukon North Slope. So that -- I think the application is closer to home in that respect. If you will forgive me this opinion, I think that we as a company have dealt pretty well with the frost heave problem ourselves. We do not know anybody who can contribute to what we have done ourselves. At least, if anyone can, well, we would sure be delighted to get it, but it certainly would not be the Russians. The Russians have carried out a great deal of permafrost research, particularly in things like thaw consolidation and thermal modeling techniques and that sort of thing. These papers have been published years ago and while they probably were not used for the basis of what we have done,

certainly they have been taken into account by reading and studying to make certain that we take an advantage of everything they can teach us in that respect.

We had hoped that we would be able to learn something by seeing them actually constructing a pipeline in permafrost and thought that that would be an area which they have done some things that we have not, but unfortunately, we were not even able to do that and if we had we would have seen them ditching frozen ground much like, as I say, ditching frozen ground in northern Alberta today, so once again there was very little to learn.

Q So what it comes down to is this, the Russians built two pipelines in the sixties in permafrost, two gas pipelines, but they built them on piles above the permafrost so that it would only be if you were building a gas pipeline on piles that you might learn something from their experience and you say that the more recent experience of Alyeska in building its hot oil pipeline on piles from Prudhoe Bay south to the end of the permafrost zone would be more valuable to you, that is really where we are at, is it?

A That is my opinion, yes, sir. The one thing the Russians have done that we have not done yet in a massive scheme like this is to utilize a river system for logistical purposes and the Ob River is navigable for most of its length and they built wharves at the appropriate spots just like we plan to do. They were blessed by being able

to build their wharfs in non-permafrost areas where we will not , but nonetheless that experience tells us if nothing else that if you decide to do it and put your resources to it , you can get it done.

Q I -- what about Dr. Taylor, where is he now?

A Dr. Taylor has a consulting practice of his own in Calgary, sir.

Q Well, would he be the most knowledgeable man in this field, I mean, the most knowledgeable man working in Canada with knowledge of the Russian systems?

A I hesitate to say that, he probably would not forgive me if I did.
Dr. Taylor is a geologist and he has made at least one other trip to Russia. I do not believe that it had anything to do with pipelines, but I may be wrong. I know he saw this Messoyakha-Norilsk system. I do not believe he saw any of the other systems. He is familiar with what Arctic Gas's plans are, because, as I say, he did work with us for a period of time. I just do not know whether he would be the most knowledgeable or not. I would think that to find the most knowledgeable person in that respect, you might want to talk to someone in industry, trade and commerce in Ottawa, like Mr. Chiperzack who seems to host most of these groups for Canada and he would be able to point us towards the most knowledgeable person.

Q Yes, I was just wondering if they had considered chilling -- burying the pipe,

chilling the gas to protect the permafrost and had anticipated the problem of frost heave.

A Sir, since the Canadians have been visiting with the Russians and the Russians here in Canada, they have certainly become exposed and knowledgeable to our plans for using a chilled gas pipeline and the cost of chilling is certainly not cheap, it is very, very expensive and as their permafrost appears to not be as severe as ours, I would suspect that they have taken the most economical course to them, which we don't think is the most economical course as far as we are concerned.

Q Yes, well, thank you very much, Mr. Fielder. I am sorry to have interrupted you. I should say that I think we will carry on until 5:30 at the very least today and those whose commitments to watch the hockey game require them to leave early we'll just have to function without them. I should say for the benefit of counsel that Mr. Anthony on behalf of Canadian Arctic Resources Committee made a motion about the taking of evidence regarding alternate routes at the conclusion of phase one and I intend to give my ruling on that subject tomorrow.

So, carry on, Mr. Lucas.

MR. LUCAS: Thank you, Mr. Commissioner. Mr. Anthony has been waiting with great expectations. He's be very pleased to hear that, I'm sure.

Q Now, Mr. Hurd, I referred you to question 22 in the responses to the Pipeline Application Assessment Group, especially on page 22-4, where you have set out an illustrative situation in which a break has occurred at a particular spot on the North Slope, on the Prudhoe Bay lateral. Now would you also refer to one of the route maps in Section 13 A, because I'm going to give you a slightly different hypothetical situation and ask for your explanation as to how the contingency would be handled. So the map is 1 C-0211-1001, and that's the -- it covers approximately Milepost 240 to -- this is on the Prudhoe Bay lateral.

WITNESS HURD:

A Yes.

Q Do you have those references, Mr. Hurd?

A Yes.

Q All right, I'd like to ask you to assume that a break occurs in the vicinity of Milepost 290 on the Prudhoe Bay lateral, and that would be between compressor station CA-06 and CA-07. Now, I would ask you further to assume that it occurs during the period August 15th to October 1st, in the late summer but prior to freezeup. Now, during this period, snow geese are staging on the North Slope of Alaska in the vicinity of the assumed break in preparation for the flight south.

A North Slope of Alaska, Mr. Lucas?

Q On the North Slope of Canada, in the area of the assumed break. Now, I would like you to run through the sequence of activities that would take place to deal with a break in that area at that time.

A Each of the contingency plans, Mr. Lucas, for such an event is a study in itself, and a lot of work would go into developing the plan for a break that occurred in that area. We can touch on the major parts of such a plan that would be developed. It wouldn't be in the same detail, I don't think, that you found in question -- the response to question 22.2, nor in the same detail that appears in a similar description in 13 B.

Q So you would develop a separate contingency plan for each area?

A That's correct, yes.

Q How large would each area be?

A They would vary. It would depend on the circumstances or the physical setup where the river crossings are, where equipment is, where major air strips are, the type of terrain that we would cross, whether there are potential environmental disturbances at certain times of the year, as this one would have.

Q So you can't tell us which areas will have separate contingency plans.

WITNESS FIELDER: Could I help a little bit in that respect? Access to the side of the break would normally be from the compressor station closest to it, providing that river crossings were not a particular problem. So as one basis we would consider preparing contingency plans for sections between compressor stations, having set out prior to the time that the break occurred by means of this plan how access to any particular part of the line would be carried out.

With a separate plan being prepared for different seasons of the year, so we would know that if a break occurred at a particular time, that we'd use other aircraft or low ground pressure vehicles, whether there was an A.C.V. in the vicinity or whatever, and also of course taking into account the environmental considerations that you suggested. But that has not been done at this moment.

Q You will not have those specific plans until after final design, and after regulatory approvals?

A Until after regulatory aprovals, certainly they will be developed as final design is being developed, and this is because the contingency plans will depend upon the types of equipment we have available to us, and we won't want to select that equipment until the last necessary moment so that we make certain we take advantage of the most up-to-date equipment available to us.

Q And that means you can't really develop these plans until the last moment in

anticipation of improved technology?

A yes sir, the last necessary moment.

Q Well, Mr. Fielder, Mr. Hurd, I don't want to lose the scenario I've developed, so I'd like to ask you about that situation, Milepost 290 in the late summer-early fall. Would you anticipate using aricraft to deal with a break in that area and at that time?

A Sir, that would depend upon the necessity to get across the rivers. You've chosen the break between the Babbage River and the creek-- I don't know the name of the river that's very close to Milepost 310; but at any rate if that river could be forded with the L.G.P. equipment that we have available at CA-07, or alternatively, if the river on the other side can be forded from CA-06, it should not be necessary to access the site by aircraft; but certainly we would have to cross those river in some way, shape or form.

Now, once the break was reported, all we would know at our Gas Control Centre is that a break occurred between CA-06 and CA-07. We wouldn't know precisely the location of the break, and at that time we would have to send an aircraft out over the site to locate the break specifically; and after that the contingency plan had been organized, and incidentally been organized in conjunction with the land use people so that we can react quickly -- and I say this assuming that we can put together such a plan in

conjunction with those people to allow a very quick reaction to an emergency situation. ONce that's been done, they would be notified and the contingency plan, whatever it is, would be put into effect.

Q Could you deal with the situation that I've outlined without using aircraft at all?

A We could but we would be out of service for considerably longer, so that we at the very least we would want to locate the site of the break, using either a helicopter or a fixedwing aircraft. But certainly if we had to do it without it, we could do it. It would just take longer.

Once again, sir, that presumes that we can ford those rivers.

Q All right, so far as aircraft use is concerned, in the biological report series -- and I'm referring to Volume 14, chapter 7, it's a paper by R.E. Swinesberg entitled:

"Snow Geese Disturbance by Aircraft on the North Slope, September , 1972,"

at page 277, and I'd like to quote one of the recommendations made by this Arctic Gas environmental consultant. It's recommendation No. 7 on page 277:

"Because of the sensitivity of geese to aircraft disturbance, flights should be curtailed over the pre-migratory staging areas between August 15th and September 30th, and necessary overflights during this time should avoid areas of heavy snow geese concentration."

Now, would you be prepared to accept the constraint of that recommendation in developing your contingency plan for this particular area?

A Certainly not happily.

WITNESS HURD: I wonder if I could ask a question of Mr. Lucas? Is there -- having not read that for a good long time, is there another recommendation having to do with the altitude which small aircraft may fly in the same area?

Q Not in this particular report, Mr. Hurd.

A The answer may be in that, that small aircraft flying high enough will not disturb the snow geese. If the break is major it can be seen from a good high altitude so there may be ways without using the extra time that Mr. Fielder was talking about to do it without aircraft. There may be ways of flying over the pipeline route and finding the location of the break without disturbing the snow geese.

Q Let me put the question a little more generally. In developing your contingency plans for particular areas, are you prepared to accept the recommendations made by your environmental consultants.

MR. MARSHALL: I have a lot of difficulty with a question that is that general, Mr. Lucas. It would seem to me that in the recommendation itself it talked about two things. It talked about trying not to have over flights, but if you did have over flights, try to avoid areas of concentration so it would seem to me there are probably two things in that one recommendation itself. The question you put is of such a general nature I don't know how the witnesses can possibly answer it.

Q Well, I refer -- Mr. Commissioner, I refer specifically then to this recommendation in your contingency plan, are you prepared to accept the recommendation of your environmental consultant that I've quoted?

WITNESS FIELDER: We are prepared to consider that recommendation just like we consider every recommendation, Mr. Lucas; but it would have to be weighed in the light of the whole problem. One of the problems is -- the problems are that the pipeline must be put back together again in the shortest possible time.

Q So you can't say at present whether you could accept that recommendation as part of the contingency plan?

A I certainly accept it as a recommendation, yes.

Q But you can't say whether you would be prepared to incorporate it into any contingency plan developed for this particular area?

A Sir, that wouldn't be a decision that I would make.

Q So, we're into a policy decision again? Okay, I will note that for Mr. Horte as well.

MR. SCOTT: Mr. Commissioner, was it established that this was a policy matter for Mr. Horte? Mr. Lucas said that.

THE COMMISSIONER: Yes, I know he said that.

MR. SCOTT: I'd like to hear from Mr. Marshall, because it seems to me that this is precisely the kind of question that somebody should be answering, and if it isn't with this panel I'd like an assurance.

THE COMMISSIONER: Well are we being all together too clever about all of this. If you have a break at Milepost 290 or whatever it is, and the snow geese are staging nearby. And there is no other way of getting in there to repair the break except by using aircraft that will fly so low that they will disturb the snow geese, then once this pipeline is built whoever is running this thing, whether it is Arctic Gas or the Federal Government, that is whoever is responsible for deciding what you are going to do, is confronted with the question, well do we just forget about repairing the break and not go in until the snow geese have left?

Now, is that something you say Mr. Lucas, can be laid down in a manual in advance, or is it something which in the nature of things, a decision that is going to be made at the time, and on the spot, and perhaps hurriedly ? It's a problem and I appreciate your tackling it from the end -- from your end, but is it something these gentlemen can answer? I am certainly willing to let them try, or is something that this Inquiry really has to sort and make recommendations so that it can be dealt with in a practical way?

You can have all the most refined provisions in the contingency plan, but it may well be that when the break occurs on the spot, someone will say "let's fly a Hercules in there, and get that thing repaired". That's what we are dealing here, and certainly you carry on and tackle it from your end. Sooner or later we'll get to the other end of those questions; how is this going to be handled at the time. I know that later on in the Inquiry you will have plenty to say about that.

MR. LUCAS: Well, Mr. Commissioner, I am not attempting to plumb the depths with these gentlemen to try to discover how detailed and sophisticated and complex the contingency plans really are. What I am trying to find out is whether there really are any contingency plans.

THE COMMISSIONER: Well, that you certainly can try and find out.

MR. LUCAS: I am making slow progress in that regard Mr. Commissioner.

MR. SCOTT: Mr. Commissioner, respectfully also, there is one other question inherent in Mr. Lucas' question before we get to the different scenario that you put, in which there are no altnernatives except to go in with a Hercules or leave the pipe broken for four months. And the second possiblity is that there will be a committment by Arctic Gas to develop contingency plans in which precisely that kind of recommendation is acted upon.

As Mr. Marshall points out it doesn't preclude flights, it specifically contemplates the kind of flight and areas to be avoided and so on and so forth. My concern is to support Mr. Lucas and determine from whom we may ask the questions as to whether those recommendations are going to be accepted and acted upon. I can understand if this panel says,"well, that's a question of policy, we can't answer questions like that" On the other hand, if Mr. Horte can I'd like to have the assurance that he will be able to do so. It may be something for Phase 3, in fact, rather than Phase 1.

WITNESS FIELDER: I'm sorry, I didn't say it was a matter of policy and I didn't intend to.

THE COMMISSIONER: Well, Mr. Lucas, you carry on. I only interrrupted you because I was in a sense thinking out loud about the ramifications of the question you were asking, and they are good questions, and important questions, and I just wanted to make sure we all understood how good they were before you carried on with them.

A May I add another thing Mr. Lucas, to my last comment? What I meant when I said that it was not a decision for me to make, I meant that it wasn't a decision for me to make in isolation, and that we would certainly accept the recommendation of Mr. Schweinsburg, but there are other people who make recommendations as well. I suspect someone who's perhaps more interested in mammal life than bird life, might be concerned about a hole being left in the ground where animals could harmed if they fell into it for example. And would be just as anxious as we are to see that hole repaired, and hence we would need to take into account the recommendations of everyone, and they are not always the same recommendations. Quite often they are opposed. And then decide how the situation would best be faced.

All I meant to point out to you is that we would take the side of the people who wanted to get the line repaired quickly, because that of course is one of prime considerations.

MR. LUCAS Q: Mr. Fielder, Mr. Hurd, just picking up on something that I think Mr. Scott said a few moments ago. To pull back a little from the worst case situation that I think was suggested by the Commissioner, I would like to quote a passage from the Alaskan Arctic Gas application. From the volume entitled " Environmental Report", and under the heading "Monitoring and Preventive Measures, at page 17, and I quote --

THE COMMISSIONER: Excuse me, this is the Alaskan Arctic Gas application to the F.P.C.?

MR. LUCAS: Yes, sir.

Q I quote, " because of the sensitivity of snow geese to aircraft disturbance, flights will be curtailed over the pre-migratory staging areas between August 15th, and September 30th. Necessary overflights during this time will maintain a 1000 foot minimum altitude and will avoid areas of heavy snow goose concentration."

Now, is Canadian Arctic Gas willing in terms of it's contingency plans at present to make the same committment that the sister company, Alaskan Arctic Gas has made in its application?

WITNESS HURD: A The phrasing there has the qualification that I wondered about earlier, and that committment, yes, Mr. Lucas, we would make that.

Q So, you are prepared to give us in Canada the same committment that you give the American people in that regard?

A Yes. It is a more reasonable condition to apply on the operating practices. You see, it allows flights above a thousand feet. At that elevation a major break could be seen. As Mr. Fielder explained the first purpose of flying over the area would be to determine where the break is. From that point on the repairs could be carried out on the ground.

THE COMMISSIONER: Could I just ask -- You are assuming a break could be seen from a thousand feet in the air. That would be what I

think was described as a longitudinal rupture of the line that might extend for -- I've forgotten the lengths that were given to us, but perhaps hundreds of feet. Is that the kind of rupture you had in mind?

A I wasn't -- I didn't have in mind a break quite that large sir. One large enought that it could be detected at the compressor stations on either side of the break, by changes in flow rates and pressure levels.

Q Oh, there's no doubt about that. The people at the compressor stations will understand that something was amiss. I was -- when we had the design panel here, there was a good deal of discussion about this subject. You may have been here, and heard what was said then. My impression was that a tendency, if a break occurred in this line, would be for it to rupture longitudinally. The suggestion was made that that rupture could extend for hundreds of feet. There was a gentleman who discussed that at length; his name, forgive me I can't remember, but everyone else will remember.

MR. MARSHALL: Mr. Holmberg.

THE COMMISSIONER: Mr. Holmberg, yes. I was going to say, Mr. Homer, but it's Mr. Holmberg. That was the purport of his evidence, and if you're not thinking of a rupture of that nature, what kind of a rupture are you thinking of?

A ANy rupture large enough to allow a reasonable percentage of the total gas flow to escape.

Q Yes --

A So that it could be detected at stations on either side of the break, would release enough gas and disturb the surface over the pipeline enough in my view that it could be seen from 1,000 feet.

Q Well, a break that would disturb six feet of earth cover in an area large enough to be seen from the air, that would be a break that if the pipeline were above ground, would -- well, even if it were not above ground, that would be a break of real significance. It would be a break of the type,wouldn't it, that Mr. Holmberg discussed even if it did not extend for hundreds of feet?

A Yes.

Q See, as I understood it, he said that if you got a fault or a flaw that -- or if there is some exterior cause, some exterior force were applied, once it occurred, even if it were over a very limited area of the pipeline, of the steel, the tendency would be for it to progress logitudinally and almost instantly for hundreds of feet. That -- I am recasting his evidence in a very rough fashion, but that impression was left with me. I have in mind what you have said and what everyone else has said that these things are very remote possibilities and

so forth, but if all of that is occurring under the ground, then you say it can be observed from the air. I should think it could be.

Well, forgive me, I seem to be doing most of the talking this afternoon, but then, I am entitled to it now and again.

MR. LUCAS: Thank you, sir, I am almost finished with these gentlemen.

Q Still with environmental conditions regarding aircraft flight. Mr. Hurd, as part of the operations and maintenance plan, as part of the contingency plans for particular areas that you mentioned, have you established rules regarding flight altitudes and flight corridors for particular areas of the route?

A Again, Mr. Lucas, these would be, those questions would be a part of the operations manual. We can say general things about them now as we have in testimony up to now, things like, while it is desirable to do the pipeline patrol at perhaps 100 to 150 feet which is quite low, in areas where there is potential disturbance to staging migratory birds, for example, or caribou, the patrol flights could be done at higher altitudes and then areas which needed a more careful check could be spot checked at that one area. The specifics would have to be part of that operations manual.

Q But specifics will be developed --

A Yes, sir --

Q -- in terms of altitude and flight corridors?

A Yes, and times of the year.

Q And they will be developed in consultation with your environmental consultants?

A Yes, sir.

Q But this won't be done, or it won't be finalized until after regulatory approvals?

A The total operations plan cannot be done until then.

Excuse me, -- operations manual is a better term. It can't be done until then.

Q Thank you, I appreciate your general answer even though Mr. Marshall won't let me ask any general questions.

MR. MARSHALL: Help yourself.

MR. LUCAS:

Q Mr. Hurd, in Section 13-B at page 25, reference is made to regular tests of sewage effluent that will be conducted to insure compliance with Government water standards. Do you have that passage?

A Yes.

Q Now, what are these Government water standards, Mr. Hurd?

A Mr. Lucas, I cannot answer that one in detail that might be useful. I am aware that

there are standards and whatever those standards are they will be met.

Q So the Government water standards are whatever the Government tells you to do?

A That was the intent of the remark, yes, sir.

Q And this presumably has been taken into account in developing the operations and maintenance plan?

A Yes.

MR. LUCAS: Thank you. Those are all the questions that I have, sir.

THE COMMISSIONER: Excuse me, where was that reference to water standards? Page what?

MR. LUCAS: It was page 25, I believe.

THE COMMISSIONER: On that page 25, I just do not see it -- under waste, disposal and water treatment?

MR. LUCAS: Yes, sir, it is the second paragraph under the heading "Waste Disposal."

THE COMMISSIONER: Oh, yes, right.

MR. LUCAS: "Compliance with Government water standards."

THE COMMISSIONER: All right.

MR. SCOTT: Mr. Commissioner, I wonder if I could put a question to Mr. Marshall that might save some time. Mr. Lucas I think fairly

graphically has -- and fairly directly, I may say to be fair -- has got the panel to agree that they will accept a constraint contained in the American application, as being applicable in Canada. It is a constraint that stipulates as to how low planes may fly under certain conditions at the staging ground. That no doubt is useful because it advances us slightly beyond the form of our application here. I wonder if Mr. Marshall can tell us whether the other constraints that are contained in those -- in that application will also be accepted here or if we must go through them one by one to determine whether the environmental concerns in Canada are going to be treated differently than they are in Alaska. I do not expect him to answer now, if he doesn't want to.

MR. MARSHALL: To begin with, Mr. Scott, I am just not certain at this point whether or not 14-C, exhibit 57 contains the same limitation in Canada, I would have to check. I don't know whether or not there are parallels throughout the two applications. It is just something that we would have to check and I can advise you on it -- after I have checked and I have got some instructions.

MR. SCOTT: Well, I don't want the advice particularly on this issue of the snow geese. I am much more concerned, if I may put it this way, about the general question. It may be that in drafting the application to the American authority it has been considered too politic to be more precise about constraints that the applicant is prepared to accept and live with.

I think it would be a misfortune if the applicant here, assuming they were appropriate, was not prepared to openly accept them for the Canadian environment as well.

MR. MARSHALL: Mr. Scott, as you indicated, it is something on which I cannot give you an answer now. I will have to check to see whether or not there are circumstances such as you have postulated and I will get instructions and I will advise you in due course.

WITNESS HURD:

A Mr. Marshall, may I elaborate just a bit. The intent of the answer to that very specific question was to recognize that snow geese do not have a nationality really, and an environmental concern in Alaska because of snow geese staging very close to the pipeline route is similar concern in Canada if they are staging very close to the route. So it is easy enough to agree that a constraint that is reasonable in Alaska because of snow geese close to the pipeline is a proper constraint to apply in Canada for the same reason.

As far as agreeing in a general way that all constraints or conditions volunteered by Alaskan Arctic in its application to the Federal Power Commission, if -- it wouldn't be so easy to agree without checking each of them that the same constraints ought to apply in Canada.

MR. SCOTT: Well, I would ask, Mr. Commissioner, if Mr. Marshall could check each of them. The point I make and I make no

criticism of the panel, was that Mr. Lucas was having a good deal of difficulty getting any precision at all whatever at all from the panel, until he read a portion of the application made in the United States whereupon the panel said, "yes, they'd accept that." Well, if he had not read that, we would be no further ahead than we were before. Now we are substantially further ahead because that has been done. I hope Mr. Marshall would have an opportunity to check that and see the appropriate cases in which the constraints accepted in the United States can be accepted here as well.

THE COMMISSIONER: Well, he says he will do that -- we can rely upon him.

CROSS-EXAMINATION BY MR. BAYLY:

Mr. Commissioner, to follow up the point that Mr. Scott has just raised, I am wondering as well whether Mr. Hurd speaks at this point for Arctic Gas or as an employee of Arctic Gas and this would have to be confirmed, that is --

THE COMMISSIONER: Well, I think what we will do is this. Mr. Hurd has spoken today and we will take it that he speaks for Arctic Gas unless somebody comes along and says later on that he did not. I think that we can proceed in that way. So the burden is on Arctic Gas to disavow, not on you to insure that he in fact has authority to say what he said.

MR. BAYLY: Thank you, sir.

Q Mr. Hurd, if we might just continue with this scenario before I get on to what I prepared as my cross-examination, referring to drawing 1C-0211-1001 again.

Have you that drawing, sir? It's somewhere near the end of 13-A.2.2, if that's any help. Perhaps to save time I could bring you one and borrow Mr. Hollingworth's. What I'm referring to in this diagram is your references in the scenario that Mr. Lucas provided, to flights over the pipeline area in which there is some sort of a breakdown or rupture. You have stated that you would be willing, as much as possible, to follow those undertakings that have been made by Alaskan Arctic Gas as to the height over which you would fly if you could see the break at this point. Now, the rules that you would set internally in your -- and put out in your manual for operations and maintenance, would I gather provide that flights shall be at least 1,000 feet during this period of time in this kind of area, would that be correct to assume?

A That sort of thing, yes, Mr. Bayly.

Q Now, because flights aren't entirely governed by Arctic Gas, I would assume that at some point you have or will have to approach the Ministry of Transport to find out if that fits in with their kinds of regulations. Would that be fair to say?

A If I understand, Mr. Bayly, you are referring to air space which is controlled by -- which is called controlled air space?

Q Yes.

A And the M.O.T. assigns altitudes and so on?

Q That's the reference I'm making, yes.

A Certainly we would comply with those regulations or assignments also.

Q So when you are preparing your manual you would have to take that into consideration?

A Yes.

Q And in this area, that is the area where Mr. Lucas has proposed that there may be some sort of a break, you would also, I assume, have to check with the Pentagon, since this is very close to a Dew Line site, and they also have controlled air space in this area, is that correct?

A Not to my knowledge, Mr. Bayly. I am aware of many flights that have been made before now over the same area, and I was not aware of any check having been made with the Pentagon.

Q All right, I don't mean that you would have to check each flight with them, but I am suggesting that you would have to, if you were devising some sort of operation and maintenance scheme in the area of a Dew Line site, have to check with them to see what their rules were, the same way you would have to check with the Ministry of Transport.

A Certainly we would make ourselves aware of what regulations, if any, or what authority, if any, the operator of the Dew Line sites

had in those areas. If that exposed some conflict with our own wishes or with the Ministry of Transport regulations, we would have to find some way of resolving that.

Q All right. Has any sort of work in this area been done by the operations and maintenance people, or is this something that still has to be done before your manual can be prepared?

A It would have to be done to finally prepare the manual.

Q Now getting away a bit from the area of breaks, but just into the area of general maintenance, I assume that you would be considering, as you have said in your 13-B portion of the application, that flights over the pipeline right-of-way at regular intervals would have to be made, is that correct?

A We would propose line patrol flights, yes sir.

Q And again you would have to check with the Ministry of Transport to see whether the operations rules for aircraft that you would propose fit in with any of their controlled air space regulations; would that be correct as well?

A We would make that check before the plan for scheduled line patrol flights was established?

Q But I take it that no such check has been made so far to see whether or not your proposals on the general basis that they have

been put forward in the application are in conflict at the present time.

A I'm not aware of a specific check, Mr Bayly. That doesn't mean that one hasn't been made. I'm not aware that its controlled air space in that area either.

Q All right. My concern is that you may decide you want to avoid a certain area on a certain day because there is perhaps a herd of caribou, and when you file your flight plan with the Ministry of Transport they say, "I'm sorry, somebody else has already filed at that altitude that way, you will have to fly a different way." Do you envisage that as a possibility, that it may hamper your doing things strictly according to your manual?

A I can imagine that that may very well happen. It wouldn't be a serious thing in the operations of the line because such line patrols can be re-scheduled and are flexible.

Q Without committing yourself to a general policy, would you envisage rescheduling as a solution to this problem on a sort of week to week basis, if these things arose when you were going to do a patrol?

A A very easy solution, yes sir.

Q All right. Now if I could have my volume back, because I've got some notes in it, I refer you to page 6 of the operations and maintenance portion under the general heading,

"Organizational structure,"

and with specific reference to the second paragraph in divisions and districts. Now you refer in that second paragraph -- and I'll read the sentence:

"The applicant plans to hire northern residents to fill its full-time personnel requirements to the greatest extent possible."

Now, as operations and maintenance people, have you developed any kind of scheme or guideline for how you will be able to implement this statement in 13-B?

A I'm not sure I understand, Mr. Bayly, what you mean by "scheme or guideline", beyond saying that to the greatest extent that's possible and practical, it is our intention to hire northern people. That's not an unusual practice for operating pipeline companies. Traditionally they, to the greatest extent practical, find their permanent full-time staff in the area in which they're operating.

Q Now when you say "local people" would you envisage designing certain programs to suit the educational problem specifically of native peoples in the area through which the pipeline route goes?

A Yes indeed, sir.

Q Now, you go on in that paragraph to say that:

"Important influences on the pipeline's full-time personnel requirements will be the success of recruitment and training programs designed to attract local residents, the productivity

and turnover of personnel, the availability of contractor and suppliers personnel, and the length of time required for individuals to become skilled in more than one basic technical discipline,"

and the sentence goes on,

"as is required on operating pipeline systems."

Now, have you designed a scheme of recruitment at this stage which you feel would be successful? Or is that something that would have to come at a later stage?

A It probably will, Mr. Bayly, have to be at a later stage for a number of reasons. Our training program has been under way or the training program that we administer has been under way for three years now, and so far is quite successful. When the time comes to staff the operating pipeline, the situation may be very different then than what it is now. We will be competing at that time with other employers for a very limited pool of potential operating and maintenance personnel.

And I don't know that it's possible at all to judge at this time or ẽstimate how many northern people will be available to go on the full-time operations and maintenance staff of the pipeline, let alone how many of those will be trained at that time.

Q All right now, looking at the program that you have developed already, would it be fair to say that that is pointed at the moment to construction rather than the later stage of operation and maintenance?

A You're speaking of the training program that we have under way?

Q Yes, I think you referred to it as the northern training program.

A It's broader than that, Mr. Bayly. It's designed to provide training -- on-the-job training, and academic up-grading for people who are directing themselves into pipeline operations and maintenance, drilling, seismic work, processing plant operations, administrative work. I am sure there are others I haven't thought of. It's an industry-wide plan.

Q Now you've referred in that sentence that I read as well to individuals becoming skilled in more than one basic technical discipline. Could you explain why a person who would be given a job would need more than one area of expertise, if I may call it that?

A It's a phenomenon that is perhaps unique to this industry. Despite the fact that the probability of a mainline break is very low, typically an operating pipeline company staffs itself to be capable of dealing with a break if it occurs. That means that a lot of people are on staff in sort of a fireman role. They're there for that important day when a break occurs. That means that to be fully, properly staffed you need equipment operators, welders, different types of equipment, side boom operators, and a great variety of disciplines. To make the operating staff more efficient in terms of numbers of people, the attempt is usually made to train people over a period of time in a variety of disciplines and decrease the total numbers of people. You still must maintain that level of staff that is necessary to go out and do a repair, but between repairs, which may be many years, you don't want a lot of people on staff that are not being used effectively and efficiently.

Q Would it be fair to say then that you would have a man trained to do emergency welding, who would also be a truck operator on your general surveillance team, if I may call it that?

A That's a possibility, yes.

Q Have you any figures on the amount of time that you would envisage for individuals to become skilled in this way before they would be of any use to you in your operation and maintenance

programs? Would it take a year or two years, or would they train on the job?

A It differs, of course, Mr. Bayly, for each discipline, and it differs according to the background skills that a trainee brings with him when he starts the program, and probably ranges from -- and it differs according to the level in the operating structure at which you hope to train the person, those things produce a range that's probably all the way from a matter of months to many years.

Q Would you envisage being able to do any of this training in the north, or would it be as the program, as I understand it, has been going on to remove people from their own areas that they live in and take them to Calgary or Edmonton to do this kind of training?

A It would be done in the north to the greatest extent that is possible or that is effective in the training program. Up till now considerable of the training has been done in the south because that's where on-the-job training opportunities are. But there's another large amount of training that's done in the north where, for example, on drilling operations, seismic operations, because there are opportunities in the north.

Q Now, I wonder if I could address a question to Mr. Carlson, who I understand has come from Trans-Canada Pipeline? Now, Trans-Canada Pipeline has a line that goes through Northwestern Ontario through areas like Hurst and Longlag, Gerraldton, Pierrdmore, where there is a large native population.

Do you, Mr. Carlson, know whether the people who are involved in operations and maintenance in that area are -- were there any of them or a proportion of them native peoples who had been trained by Trans-Canada Pipeline in operation and maintenance?

WITNESS CARLSON: Yes sir, I can't give you a precise number of northerners from Northern Ontario who have been hired and have been trained by Trans-Canada Pipelines, but yes, we have had a number of them and the number still are on staff.

Q Would you be able to say whether they represent a significant proportion of the people operating the pipeline, or are they more noted by their exceptions than --

A I think in this case they would be noted by their exceptions. It's difficult at this point for me to give a precise percentage or number, but this information could be obtained if you want it later.

MR. BAYLY: I wonder, Mr. Commissioner, that may be of some interest as it is a parallel sort of situation, if the applicant would be willing to undertake to provide that kind of information to the Inquiry.

A We'll have to check to see if it's available, sir.

THE COMMISSIONER: Trans-Canada is a member of the consortium?

A That's right.

Q So I'm sure it's available.

I think we should know that. Trans-Canada is the principal gas pipeline operating company in Canada at the moment, I think, and I think we should find that out. Are you two gentlemen, Mr. Carlson and Mr. Bayly, are you talking about -- are you using the same terms in the same way? You said "native" down in Ontario or something, and you said "northerner". Now, did you mean people who live in Northern Ontario who are natives of Northern Ontario, or did you mean native Indian people?

MR. BAYLY: I'm speaking more specifically of Indian and Metis people of that area because there may be special training problems in which COPE and its constituents may be particularly interested.

THE COMMISSIONER: Did you mean the same?

WITNESS CARLSON: Yes. I believe the number of native Northern Ontario people on our pipeline would be rather small in number, but I do believe we have had some, and they're still on staff. I'll attempt to get you some more precise information.

MR. BAYLY:
Q Thank you, sir. Now, on the programs, Mr. Hurd, that you would envisage being used, and the ones which are being used now to train people, do you know of your own knowledge whether these are recognized by the unions involved in pipelining, whether the programs give the graduates the status they need to apply for what are traditionally

known as union jobs on operations and maintenance?

MR. MARSHALL: Mr. Bayly, perhaps I should just comment, if I may. We had proposed to lead fairly detailed evidence about the training program, probably as part of Phase 4, and there are others who have been involved in it on a full-time basis, which Mr. Hurd has not been, and I thought perhaps you ought to know that, when you are addressing these questions to him.

MR. BAYLY: I think we understand that.

THE COMMISSIONER: I think, Mr. Bayly, that you might pursue this as far as you can now.

MR. BAYLY: If Mr. Hurd is aware of this, as he seems to be aware of some parts of the area that I'm questioning on, perhaps he could answer, at least to the best of his ability. I will be content with that and wait for any more full answer from other panels.

WITNESS HURD: With the qualification Mr. Marshall mentioned, that my involvement has not been full-time, I think perhaps, Mr. Bayly, all I can say that's useful is that we have been able to place trainees successfully with companies in pipeline construction situations. I'm not aware of any case where the unions involved have caused us any difficulty in placing these people at all.

Q Do you know then whether these people have been able to join the unions, or

whether they have been granted some sort of exemption or dispensation?

A I don't know that.

THE COMMISSIONER: You're talking about operation, working on the operation of the pipeline after it's built; you're not talking about construction.

A I was referring at that time to construction, sir, yes sir.

Q Oh, you were referring to construction?

A Yes, I believe that a few of the trainees have been placed on construction crews.

Q Well, in pipeline construction in Southern Canada?

A Yes.

Q Well, when Mr. Carlson was talking about Northern Ontario, Mr. Carlson, you were talking about the actual operation of the pipeline, weren't you?

WITNESS CARLSON:
A Yes, that's right, Mr. Commissioner. We did have one of the northern trainees from the program Mr. Hurd referred to working on construction, I believe, I think he was involved in welding inspection work.

THE COMMISSIONER: Well, I think we might do this, Mr. Bayly. We might adjourn now and maybe Mr. Hurd and Mr. Carlson could put their heads together and -- over night -- and tell us

in the morning
if there is anything we ought to know about the northern training program that they can tell us that might eliminate some of the confusion here. It's not confusion created by them, it's simply that we're a little -- we're not as incisive at this hour as we usually are earlier in the day.

MR. BAYLY: I'd like, Mr. Commissioner, to end at the end of the day when people get the giggles.

THE COMMISSIONER: Well, you'll have first crack at 9 A.M.

MR. BAYLY: Thank you, sir.

THE COMMISSIONER: What is the union that represents the people who operate the pipeline in Ontario, or the Trans-Canada Pipeline? What is the union that represents the people who work on the pipeline?

WITNESS CARLSON: Trans-Canada's operation does not involve any union personnel.

Q You mean the people -- you will remember, Mr. Carlson, that I visited one of Trans-Canada's compressor stations near Kingston.

A That's right.

Q Last November; none of those people belonged to any union?

A No sir. I would like to think the reason for that is that Trans-Canada's benefits are such that they don't require one.

WITNESS HURD: Mr. Commissioner,

I think we can add a similar comment respecting construction. My last involvement with the pipeline construction, there were no unions involved there either.

Q Well, where was that?

A It's in Alberta, some considerable number of years ago, I'd hate to count them.

Q I see. Well, the Alyeska Oil Pipeline, I take it the workers on that project belong to trade unions.

A Very much so.

WITNESS FIELDER:

A Sir, I think you'd find that Alberta Gas Trunkline is not unionized either, nor do I think -- I can't say for certain, but neither is Westcoast Transmission; I think perhaps it is an industry trait that the O. and M. personnel are generally not trade unionists.

THE COMMISSIONER: Well, I --

MR. SCOTT: It seems to be a fertile field to be plowed.

THE COMMISSIONER: Well, we will adjourn until 9 o'clock in the morning.

(PROCEEDINGS ADJOURNED TO MAY 21, 1975.)

MACKENZIE VALLEY PIPELINE INQUIRY

IN THE MATTER OF AN APPLICATION BY CANADIAN ARCTIC GAS PIPELINE LIMITED FOR A RIGHT-OF-WAY THAT MIGHT BE GRANTED ACROSS CROWN LANDS WITHIN THE YUKON TERRITORY AND THE NORTHWEST TERRITORIES FOR THE PURPOSE OF THE PROPOSED MACKENZIE VALLEY PIPELINE

and

IN THE MATTER OF THE SOCIAL, ENVIRONMENTAL AND ECONOMIC IMPACT REGIONALLY OF THE CONSTRUCTION, OPERATION AND SUBSEQUENT ABANDONMENT OF THE ABOVE PROPOSED PIPELINE

(Before the Honourable Mr.Justice Berger, Commissioner)

Yellowknife, N.W.T.

May 21, 1975.

PROCEEDINGS AT INQUIRY

VOLUME 42

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May 20, 1975

Page 5377	Hurst to Hearst
"	Longlag to Longlac
"	Gerraldton to Geralton
"	Pierrdmore to Beardmore

APPEARANCES:

Mr. Ian G. Scott, Q.C. Mr. Stephen T. Goudge, Mr. Alick Ryder and Mr. Ian Roland	for Mackenzie Valley Pipeline Inquiry;
Mr. Pierre Genest, Q.C. Mr. Jack Marshall, Mr. Darryl Carter, and Mr. John Steeves	for Canadian Arctic Gas Pipeline Limited;
Mr. Reginald Gibbs, Q.C. Mr. Alan Hollingworth	for Foothills Pipelines Ltd.;
Mr. Russell Anthony, Prof. Alastair Lucas	for Canadian Arctic Resources Committee;
Mr. Glen W. Bell and Mr. Gerry Sutton	for Northwest Territories Indian Brotherhood and Metis Association of the Northwest Territories;
Mr. John U. Bayly	for Inuit Tapirisat of Canada and the Committee for Original Peoples' Entitlement;
Mr. Ron Veale and Mr. Allen Lueck	for Yukon Native Brotherhood;
Mr. Carson H. Templeton	for Environment Protection Board;
Mr. David Reesor	for Northwest Territories Association of Municipalities
Mr. Murray Sigler	for Northwest Territories Chamber of Commerce

I N D E X

Yellowknife, N.W.T.
May 21, 1975.

(PROCEEDINGS RESUMED PURSUANT TO ADJOURNMENT)

MR. MARSHALL: Mr. Commissioner, you asked at the end of yesterday if Mr. Carlson could obtain some information pertaining to Trans-Canada Pipeline's hiring and training of native people in Northern Ontario, and he has been able to obtain some information and advise you on it now, sir.

DONALD ERNEST FIELDER,
LEE GORDON HURD,
MELVIN E. CARLSON, resumed:

WITNESS CARLSON: Mr. Commissioner, I checked last night. Trans-Canada does have on staff today three natives from the Northern Ontario area. We have one welder, heavy equipment operator, and a utility man. This would be three natives in an operating group of 254, I believe.

THE COMMISSIONER: What would the section of the pipeline be? You said Northern Ontario.

A That would be from a point west of Kenora to Kapuskasing. This is the central area of Trans-Canada's Pipeline system.

THE COMMISSIONER: Thank you very much.

MR. MARSHALL: Sir you also asked if Mr. Hurd might wish to add anything in respect to the northern training program that's being administered by Arctic Gas, and he has a few comments as well,

sir.

WITNESS HURD: Mr. Commissioner, we were to look into the question of any difficulties that might have been experienced in placing trainees in construction situations where unions were involved. I find that on detailed checking more recently that while there have been substantial efforts to place trainees in construction, there has been relatively little pipeline construction over the past two or three years, and our efforts have not been as successful as I thought they were yesterday. We have had one trainee in a construction situation working for a contractor doing some pipeline construction work for Trans-Canada Pipelines. In that situation the trainee was an employee of the owing company and was doing inspection work on the construction. He is a ticketed welder, doing inspection of construction work and in that situation was not required to be a member of the union. There have been discussions with unions and pipeline contractors associations -- Association of Contractors -- directed toward arranging that trainees may be placed in construction situations and that that situation might be accommodated by unions. We have every reason to believe that that can be successfully worked out, but at this stage we have not had people as union members -- trainees as union members.

I might add in perhaps a clarification of another remark I made yesterday, having to do with the extent to which construction companies are unionized. While it's true that operating

companies in Canada tend not to be unionized, the construction companies in recent years have become very much unionized, and there are only one or two exceptions now of major contractors who are not unionized.

CROSS-EXAMINATION BY MR. BAYLY (CONTINUED):

Q Now, in the application, Section 13 B, there is a reference to the men who will be working in the operation and maintenance phase, moving from one place to another. Has any consideration been given by your group or people that you know of working for Arctic Gas to accommodate the families of people who would be employed in operation and maintenance, or would those workers be living under bunkhouse type conditions, or men's quartering conditions?

WITNESS HURD: Yes, Mr. Bayly. There are perhaps two categories of people, the first being those people who would be based permanently at one of the three division headquarters which are Inuvik, Norman Wells, or Fort Simpson. In those situations we contemplate that employees would be housed on a permanent basis at those locations, and we have considered the various means of providing housing for them, which would include assistance where that was necessary to the employee to construct his own family dwelling. Other co-operative means, perhaps with government, to provide housing for employees at those locations.

The other category is situations

where people would be hired on a temporary basis for special maintenance jobs and would come from settlements other than the three that I mentioned. In those cases we have not given consideration to providing housing or assisting in providing housing in those locations other than Fort Simpson, Norman Wells and Inuvik.

Q Would it be fair then to say, Mr. Hurd,that an employee who wanted one of the permanent operation and maintenance positions would have to either be a resident of one of those three communities or would have to relocate himself into one of those three communities?

A It is probable, Mr. Bayly. I can't think of a situation now where an employee could be permanent with the company and based in another location. That is not to say that we couldn't find a situation. As the operations plan is more accurately defined it may be quite practical, but as we see it now, the permanent employees will be based in those three locations.

Q If I can turn now to Mr. Fielder. Sir, you showed us some photographs of the low ground pressure vehicles, some of which appeared to come from magazines and were in the drawing stage. Can you tell me whether all of those low ground pressure vehicles have actually been developed and put on the market or whether some of them are still in that -- on the drawing board stage, if I may call it that?

WITNESS FIELDER:

A No, Mr. Bayly, every vehicle that I showed you on the screen has been designed, constructed and operated.

Q Now, you showed us a vehicle which doubled as a wharf and as, if you will, a kind of --

A -- ferry.

Q -- ferry or scow. Is that one that has been marketed for the purposes you intended or is it one that could be adapted in your opinion to the various purposes that you see one being required for Arctic Gas?

A As I understand it it has been used in the purpose for which I showed it but not in the Arctic to my knowledge, Mr. Bayly. It's, I understand, quite common in swamp areas.

Q Has it been tested in the Arctic,when you say it hasn't been used do you mean it hasn't been tested or it hasn't been employed commercially?

A To my knowledge it hasn't been used at all in the Arctic.

Q Would that have to be done before you could determine whether or not it were suitable?

A Yes, sir.

Q Now, if I can refer to page 12 under the heading, "Aircraft" in 13-B. I am referring to sub-paragraph C which refers to a type C aircraft. Mr. Hollingworth went into what it would probably be and it appears that it would be a Hercules or something similar that would carry the same kind of payloads and perform that way.

A That is correct.

Q And that particular aircraft in 13-B it is suggested that that one would be

chartered from a commercial airline , I assume. Can we then infer that types A and B will be owned by the company or will they also be chartered?

A Sir, that is a decision that we just have not faced yet. We plan to have a study completed, oh, hopefully before the end of the year or by the end of the year which will indicate to us the use that we will probably require of aircraft on a weekly basis or monthly basis to help us decide whether or not we really should have, for example, one type aircraft -- type A aircraft per district or one per division or one chartered or two per district or just whatever is most logical, but we just have not got to that point yet.

Q Now, when you say that you have not got to that point, may I infer from that that you may not have got to the point of knowing how frequently you will have to use the various kinds of aircraft to do your operation and maintenance?

A No, we have made an estimate for planning purposes as to the frequency of flights that are expected. We haven't pursued it to the point of estimating contingency flights and the like yet.

Q Can you infer from that how many aircraft you would require along the length of the line in the Northwest Territories in order to effectively carry out at least your basic patrols. I realize that you have not done it for the contingency problems as well.

A Yes, certainly that would

be one of the things that would help us make that decision, Mr. Bayly.

Q All right, but I gather you have not made the decision as to how many aircraft would be required? I don't mean to be bought, but just to be used, whether they are bought or leased or chartered.

WITNESS HURD:

A Mr. Bayly, may I elaborate a little on Mr. Fielder's comments. As Mr. Fielder said, we have a reasonable fix on the need for aircraft, certainly in the cases where they are to be used for scheduled patrols and that sort of thing. Difficulty with determining whether they should be owned by the company or leased has to do very much with to what extent will lease aircraft be available in the area some years down the road and of course that we can't know accurately at this stage.

Q And you say that -- or Mr. Fielder says that we can expect something on this by the end of the year. Has an approach been made by Arctic Gas to the various chartering companies, to your knowledge, to find out whether they will be in a position to lease the aircraft required, or is that part of the study that you contemplate being done?

WITNESS FIELDER: Neither one, to my knowledge, Mr. Bayly. You see our operations are not intended to start for several years, and it's a little early, we feel, to be asking charter companies what kind of equipment they will have available, say five years down the road.

MR. BAYLY: Mr. Commissioner, as this relates to the impact on the use of aircraft in the Mackenzie District. I would hope that this report would be available to be tabled at some point before the Inquiry is finished because I believe that it is relevant to the considerations that you sir have to make, and hopefully this will be ready by the end of the year /and perhaps Mr. Marshall could give us some idea at some point fairly soon at what stage that report is, and perhaps a better estimate of when we might expect it.

MR. MARSHALL: We could check, Mr. Bayly, to see what stage it's at.

MR. BAYLY: Thank you, sir.

Q Referring to page 20, under 5.3 which deals with at compressor stations, I gather the decision has been made, even though the

type of turbine hasn't been determined, that the compressor stations will be unmanned; is that correct?

WITNESS HURD: They'll be designed, Mr. Bayly, and constructed with that in mind, that they are capable of operating by remote automatic control, unmaned. I wonder if I may qualify just a bit? At the same time we have designed a staff that provides an adequate number of technicians to place at least two men at each station for a break-in period that we don't know how long it will go on.

Q Perhaps Mr. Carlson could go on with this. As I understand, some of the Trans-Canada pipe compressor stations were originally designed to be unmanned but were later manned. Is my supposition correct, sir?

WITNESS CARLSON: Yes sir.

Q Perhaps you could tell us, if you know, the reason why the decision was made to man the previously unmanned compressor stations?

A Most of Trans-Canada's compressor stations are designed for remote control attended operation. Now in the early 1960's the concept of remote control unattended operation was at its infancy. We did have operating problems initially during that period of time. I should add we also had a tremendous expansion program under way which added about 800,000 horsepower to our pipeline system from the period, 1960 to 1964, and about 2,000 miles of large diameter pipeline in 1962 to 1974. The demands on our personnel including the operating people, many

of whom were devoted to the construction work, were such that we did not have the time to debug the unattended or the remote control features of the stations that were designed for unattended operation. I might add, a study was initiated by Trans-Canada within the last three months to review this concept, and I'm quite sure there is a good possibility that many of the northern remote stations on Trans-Canada's system will in effect revert back to unattended operation. Now, since the early '60's many other transmission companies have also gone for the remote control unattended operation concept, and I understand that the technology has increased greatly over the years, and successful reliable operation does exist for this type of facility.

Q Would you say in your opinion that the debugging has reached the stage where these are at that level of sophistocation that they can remain unmanned?

A Yes sir.

Q Now, you've referred to a report which was being prepared. I'm wondering whether you know if this is a report that is to be made public, or one that is to go to Arctic Gas?

A This was an in-house Trans-Canada Report that the operating group is working on to come up with recommendations for the remote controlled operation of some of the northern stations.

Q Now if I can refer to page 23 under the section that begins at page 22, 5.4.2

called "Line Patrol", the three methods of line patrol are outlined, and if I may read the sentence that begins at the bottom of page 22 to the panel:

> "Where there is a possibility of disturbing wildlife by aircraft patrols, the patrol program may be supplemented by ground patrol carried out in a small vehicle suitable to the terrain of the particular right-of-way being patrolled or on foot by at least two specially trained individuals."

I have two questions arising out of that. One is with regard to the small vehicle, what sort of small vehicle would you contemplate using, Mr. Hurd?

WITNESS HURD: Probably, Mr. Bayly, a personnel carrier, an L.G.P. type assuming that the environmental sensitivities occur in the summertime, which generally they do, and that the surface is unfrozen so it would be a tracked vehicle capable of carrying two or more people.

Q And when you say "a small one", it isn't one of the ones we saw in the photographs that were shown to us by Mr. Fielder, it's something quite a lot smaller, the size of a pickup truck, or larger than that?

A The size of a pickup truck or smaller.

Q Now, the other question arising out of this is how do you specially train people to do this foot patrol?

A The training would include two aspects, I'd think. One, having to do with the particular environmental sensitivity that caused us to go to the foot patrol in the first place. They must be aware of what that sensitivity is. Secondly, what to look for on the right-of-way, not that any of that is very elaborate. They would need to look for areas where there is erosion occurring or there is a potential for erosion to occur. They would look for evidence of gas leaks although that is a very unlikely thing for them to find. While they were on the ground they might do some minor routine maintenance of valve assemblies as they went by them, that sort of thing.

Q Now, on these foot patrols, I assume they would be carrying some sort of tools and given that they would probably be doing so, would they be equipped to stay overnight or would they only be able to do a patrol long enough to go from one spot where they could be picked up by some form of transportation to another?

A I can imagine that both might be the case. If it was possible for them to patrol on foot through the sensitive area they would not need to stay overnight and they could be dropped by a helicopter at the start of their patrol and picked up by one at the other end.

Q Now, when you say they would be specially trained I am assuming because there are a large number of things that could cause sensitivity either to the ground or to the water or the animals or plants that you would have to do this training prior to the individual jobs. Correct me if I am wrong, but I am assuming that you wouldn't train your two or more foot patrollers in all the possible ecological problems, if he was going through a goose nesting area you would tell him to watch out for eggs. If he was going through an area where the ground was particularly sensitive, you might equip him with special shoes. Would that be fair to say? They might be absurd examples, but you would look for specific sensitive areas and instruct him on the spot for those, would that be fair to say?

A Yes, that is correct. I might add, Mr. Bayly, that probably the most important tool he would carry would be a small radio that keeps him in contact with the operating base and he can get advice as he needs it through the radio.

Q Now, allowing that you do not expect a major failure, is it not true that a major failure if it did occur might well be accompanied by a fire that could spread to either the tundra or the surrounding bush depending at what point in the line it did occur?

A When major failures occur, they are often accompanied by fire.

Q Have you worked out

contingency plans for the things that would have to be done in the event of such a fire?

A Again, Mr. Bayly, not in the detail that would be contained in the operations manual. We have determined that people working on the right-of-way at times of the year when fire is a possibility would be equipped with extinguishers and equipment that they would need to control a fire.

Q If there were a pipe break and that kind of fire I am assuming that an extinguisher might well be fairly ineffective. IN other words, if there were a fire that resulted from a break it would be quite a large fire, would I be correct in assuming that?

A During the time that the gas is blowing down from the pipeline, the fire is quite large, yes. That lasts only for a very short time until that section of the line is depressured. The fire remaining after that which is burning the tundra would be a lot smaller fire and extinguishers would handle it.

Q I am assuming that in the event of a large fire that the operation and mainenance staff would probably not be adequate to fight it but that the lands and forests authorities would have to be notified so that their personnel could assist you, would that be fair to say?

A The -- one of the instructions in the O and M manual would be the requirement that the proper authorities are contacted in every case

when a fire is spotted.

Q Now, one of the things that you referred to in the question of fires is found on page 33 of 13-B. I am referring to the section that you call, "Forest or Tundra Fires". In the middle of that paragraph on page 33:

"Requested manpower and equipment which is not basic to the continuous safe operation of the pipeline will be made available to assist with the control of such fires."

Now, have you worked out procedures for deciding which equipment will be available and following that, which equipment that the authorities who put out fires could rely on from the gas company?

A I am sorry, Mr. Bayly, procedures for determining which?

Q Let me give you an example of it, because it may make it easier to understand. Assume there is a fire and the lands and forest people phone you up and say, "Look chaps, we need two L.G.P.s, an aircraft and a bulldozer, can you supply it?" I am envisioning situations where you might say yes and other situations where you might say no, today's the day we take the L.G.P. out to check compressor station CA-06, therefore, you can't have it. IN other words, a decision has to be made. Is it an on the spot decision or is it a decision that the fire fighting authorities could rely on if they were looking for equipment?

A It's one that would have to be made on the spot. The basis of that decision though, would be pretty much what the statement says, any equipment which is not basic to the safe, continuous operation of the pipeline would be made available. A routine check at a compressor station would not be considered basic to the safe and continuous operation of the pipeline and that would be rescheduled so that the equipment could be made available to fight the fire.

Q So you would envisage a situation where Arctic Gas would strip itself down to the bare necessities for the safety of the pipeline and be prepared to loan or rent or whatever, any other equipment in the area that would be useful.

A Yes, We would--- there's a limit, I suppose, to how far the equipment could be moved. I suppose the ridiculous extreme would be a fire that occurred 500 miles east of the Mackenzie River Valley, to move equipment that far would put the safe operation of the pipeline in jeopardy. But anything reasonably close would be -- a fire reasonably close, equipment would be made available to fight that, yes.

Q How would this decision be made, Mr. Hurd? Could the man on the job, the district supervisor, make this decision, or would it be one that you would envisage being referred to say your operation and maintenance headquarters?

A I think the district man would make the decision, that and pretty much all other things that he does, of course, he's in touch with the Division Headquarters and so they would be aware; but either way the decision could be made about the same rate. The communication is instantaneous nearly.

Q Have you envisaged the situation that occurs in other parts of the country when there is a major fire, that the fire-fighting authorities recruit whoever they can find to assist them in fighting the fire, rather than asking permission? They just come and get them.

A Yes.

Q And has this been worked into your calculations for operation and maintenance, and have discussions been held with these authorities?

A I'm not aware of discussions having been held with authorities. We don't see it, we have considered it and we don't see it as a large problem. Again, because of the statistical probability of the pipeline company needing that equipment at any point in time, the chances are so small that there would be a conflict that it's not a concern.

Q Would you envisage before you got into the operation and maintenance stage, having these sorts of discussions so that you could maintain security and operation while still assisting whatever the authorities requested?

A Yes indeed.

Q Now, on page 31, when referring to major station repairs, that is Section 62, I'm referring you to the third paragraph in 6.2, it refers in that to critical spare parts being readily available. Have you worked out a definition of what critical spare parts might be?

A I'm not aware of a list that has been developed. It's a fairly straightforward operation for the preparation of that list, it's fairly straighforward for an operating company, pretty standard practice among operating companies and we could name several things that would be included on the list, if that would be helpful.

Q What I'm mainly concerned with, without getting into the actual list of things which you consider critical, is whether this

involves a listing that has or hasn't been done simply because it seems to me there may be things that break that haven't been thought of as critical at one point, but become critical because they're broken. Is that sort of thing a problem?

A If it did happen and the spare parts were not available either at the station site or at the division or District Headquarters, or from a supplier very quickly, then we were not careful enough when we made up the list.

Q All right, then I'm assuming that some of the criteria are not only what you think is likely to break, but how hard it is to order the part if it has to come from a far-off part of the world. I assume you'd try and stock it just in case it does break.

A That's correct, yes.

Q If it's available at the local garage, you don't.

A That's right.

Q Now, on page 33, 6.3.2, you've referred to environmental considerations. I won't read that paragraph to you. You did read it to us earlier on. I'm thinking of the pre-formed blankets or mats of straw. I'm assuming an area of damage of some size. Would you envisage having some factory pre-form these blankets and sending them out, or what does that refer to?

A I expect, Mr. Bayly, there are a variety of different types. Any material

that will provide the insulation that's been removed by the fire would do, and straw is a good example. That sort of material would be used, the hold-down netting would only be required if it was a light material that might be blown away by the wind. I don't know that I can add much more than that.

WITNESS FIELDER: I can't add a great deal. The intent here is to do very much the same sort of thing as you might do if you're trying to grow a lawn on a slope, that is to put down some burlap sacking or something like that which would tend to hold the surface in place until you have a grass catch, and in this instance the intent would be to put down some straw and then cover it over with something that would hold it in place.

Q I'm a bit worried about this because I'm envisaging a fire that covers an area larger than a lawn, perhaps a fire that covers several square miles, which may not even be classified as a major fire, and these pre-formed blankets covered either with chicken wire or plastic netting is going to cover a very large area, perhaps, even in a small fire in terms of the amount of material that would have to be brought in for this sort of thing. There are two concerns. One is that the material may or may not be available, and I'd like you to comment on, in the first instance on whether you've investigated that.

WITNESS HURD: Mr. Bayly, maybe this would help. There will have to be a limit

to the amount of surface vegetation repair that could be undertaken by the company, or any other single entity in the Arctic. You will forgive me for going--taking the extreme to its ridiculous end. I think the company could not undertake to repair all damage done by all fires in the north for all time, so that the operating company's concern will be to repair damage caused by fires started by the company, certainly in all cases. We think those are specifically not noteworthy. Where a fire is started by some other cause and crosses the pipeline right-of-way, the pipeline company's first concern would be to protect that narrow strip along the right-of-way which might be subject to erosion if corrective measures were not taken.

Q If I understand you then, Mr. Hurd, the pipeline company is prepared
(a) to do all repairs to all fires started because of its own fault, and
(b) to repair the right-of-way where the fire hasn't been caused by its fault, that crosses the right-of-way and perhaps threatens the integrity of the pipeline.

A That would be the general rule. I suppose there is a statistical chance that a fire could be started by the company's operations that would go some distance and there may be a limit to resources of the company to repair all of the surface that may have been damaged by that. It seems such an unlikely thing that it hasn't been a concern to us.

Q Allright, we are still, though, faced with the problem of the large area being wired together and covered with straw and I am assuming that there is a limit to the amount of that that you can do. You would have to look for another method in a large fire that might perchance be caused by the company, its employees?

A It does not seem that the area wouldbe that large, Mr. Bayly, if -- Our first concern would be to prevent erosion along the surface of the right-of-way over top of the pipeline where erosion could damage the integrity of the line. Other areas well beyond the right-of way, some,perhaps more time can be used to make that repair. It is difficult to be specific.

Q This is why I am worried about this paragraph. It doesn't seem very specific. Would you envisage just using the technique that you have described in this paragraph on the right-of-way itself and perhaps employing other techniques off the right-of-way if you employed any techniques at all?

A It is very likely I would think, that other techniques would be used off the right-of-way, yes.

Q So this, if we can narrow it down, this paragraph refers to what you would, do to make sure that your right-of-way, if it were damaged by fire, did not erode away?

A That is correct, yes, sir.

Q And it may or may not refer to other areas which are damaged by a fire that

gets off the right-of-way.

A Yes.

Q Now, Mr. Fielder, just one question on the presentation you made on the Russian pipeline facilities. It is just a question of clarification. How much of the facilities you described were actually seen by the Canadian delegation of which you were a part?

WITNESS FIELDER:

A Sir, we did not visit Yakutsk. We did not visit the Messoyakha-Norilsk system at all. We visited a portion of the Medverzhye-Punga system. If you recall the map, we flew from the city of Tuymen to the settlement of Nadym and Nadym is located between the Medverzhye field which would be to the east of it, and the Long-Yuganskaya compressor station which was to the southwest of it. We flew the first day about 30 kilometers to the right-of-way and 20 or 30 kilometers down the right-of-way to this compressor station. At the time there was a covering of snow on the ground, I would estimate six inches, something like that and we could see mounds on the ground surface covered by snow which the Soviets told us were bermed 48" and/or 56" pipelines. We were never able to land on the right-of-way and confirm that that was the case. We have no reason to doubt it of course. We landed at the compressor station I named and we toured that compressor station very thoroughly. The following day we flew from Nadym where we had overnighted

into the Medverzhye field along the pipeline right-of-way which, gosh, must be 50 kilometers, something like that, to the Medverzhye field wherein we toured two gas treatment plants, one that had been designed and constructed by the Soviets and the other by the Italians, I believe, on a turnkey basis, and between these two gas treatment plants overflew the pipeline facilities connecting them. We then flew farther out into the field, circled a drilling rig and flew back home. So that is the extent that we saw it.

Q So with the exception then of landing and visiting the compressor station and going back to the Medverzhye field and touring the processing--

A Gas treatment plant.

Q -- or treatment plant, those were your two experiences on the ground. The rest of the facilities were only seen from the air?

A That is quite correct.

Q You were able to guess or surmise, I am assuming that the pipe, the 48" pipe was covered by a berm, is that correct?

A In fact, Mr. Bayly, in places it was nolonger covered by the berm. We could see places where berm restoration work was going on. We had been told that bermed pipelines, they often fail annually and that annually they went back and rebermed them. So far as I am aware, the pipe stayed in place, but the covering itself had to be replaced.

Q Was this referred to you as

an erosion problem?

A Yes, sir, as I understand it is the spring runoff that carried it away.

Q Were they able to suggest any techniques that they were trying to make sure that the berm did not run off every spring in the areas where there were streams, I am assuming?

A Yes, sir, they showed us their design for allowing water to cross the bermed pipeline and essentially what is done, the pipeline is bermed over by first of all by building up a gravel pad, perhaps a foot thick, the pipe is laid on it and then the berm formed over top of the gravel pad or the sand pad and the pipe. Perodically where they judge the water should cross the pipeline, they just didn't install the gravel pad and they didn't install the berm so that pipeline just bridged that gap. The problem, I think, and this is a Fielder opinion and nothing that the Soviets said, but the problem, I think, is that they are working with well-drained, dry sands and they are not cohesive. They don't tend to stay together and as they are operating a warm pipeline, any moisture that does get into this sand berm that might make the sand more cohesive is driven out by the warmth, in other words, the sand is desiccated even, so they do not have a solid mass to stay over top of the pipeline as they would under other circumstances.

THE COMMISSIONER: That's the Medverzhye system you're discussing now.

A Yes sir.

MR. BAYLY: Did you note whether or not they were using low ground pressure vehicles in the repair that you saw being done, or was this just areas of repair that you saw?

A No sir, it was late November when we were there, and the ambient temperature was in the range of 30 below, so I would assume because of the relatively light snow cover that the ground was probably pretty well frozen, and we saw large backhoes and drag lines and that sort of thing working, the same sort of thing you'd see working anywhere else.

Q Now, on the subject of air cushioned vehicles which you've discussed earlier, in answer to Mr. Hollingworth's questions in cross-examination --

THE COMMISSIONER: Excuse me. Just before you go onto that, you said in the report you presented yesterday something about the size of that Medverzhye gas field.

A Yes sir.

Q When you were in Russia was there any -- did anyone say that they had such notions as proven reserves and potential reserves? Was any light shed upon the real meaning of the figures that you were given regarding the size of the gas fields in the Medverzhye area?

A Yes sir. There are several gas fields in that general area, and once again as I say, first of all there were five fields named, and the first was called Urengoy, and it has proven reserves of 4 trillion cubic meters. Zapolyarnoye has 1.5 trillion cubic meters. Artichascoga has 1.5 trillion cubic meters. Ingubinskaya has 2 trillion cubic meters, and Medverzhye, 1.5 trillion cubic meters. Now these are proven reserves for individual fields in their area. While we were touring one of the gas treatment plants, we were hosted by a Soviet geologist who was, we understood, one of the people who actually discovered the Medverzhye field, and he talked to us quite a little bit about the general area and said, "The general Medverzhye area," which he did not describe by setting boundaries, "had official proven reserves of 14 trillion cubic meters." That's the published figure, so to speak, but in my report these are in quotations marks. In other words I'm quoting him directly. He said, "Local geologists think that 22 trillion cubic meters is closer to being correct." In pursuing that with him we understood that the Soviets, contrary to what is normal here, don't feel the need to go out and define the limits of a field once they find it. They get the feeling that it's a big enough field that it's worth developing, and they start to develop it, and as they are able to increase the facilities in the field, they just expand the field and they just keep moving out drilling and building out towards it to

service it. So this is why he was suggesting that 22 trillion was closer to the right number. Then I pointed out in my report that Prudhoe Bay has less than 0.8 trillion, so it gives us a feeling for the huge amount of gas that they have.

The other thing that makes it possible for them to operate in the manner in which I've just described is that the gas industry in an area, like Western Siberia, is controlled by one group. That is it's the Gas Ministry's responsibility to carry out everything that's involved in the locating and delivery of gas. They told us, for example, that they had a budget for 1975 of 800 million rubles, and it's something like $1.30 per ruble, that's over a billion dollars, and this includes the geology work, the seismic work, the drilling, the development of gas-gathering facilities, and treatment facilities, the pipelines that are required, the compressor stations that are required, the settlements that are required to house the people, the herds of dairy cattle that are required to feed them, and each and everything that goes along with the development of that field. It's a huge complex, and hence one can control every facet of it in that fashion.

THE COMMISSIONER: Thank you.

MR. BAYLY: Q In your evidence, as I stated, in your cross-examination bv Mr. Hollingworth you were referring to the A.C.V.s and the types of slopes that you would contemplate having difficulty with on their own, which they would

require assistance. Now, one of my concerns is that you contemplate in some areas surcharging the pipe with a berm, which may be as high as five feet in height. Has this been taken into consideration in deciding whether or not self-propelled A.C.V.'s can be used in the way that you had contemplated earlier?

A You mean would there be a problem in crossing the right-of-way should there be a five-foot berm across the right-of-way?

Q Yes.

A Well, just in a general manner, Mr. Bayly, the inclusion of an air cushion vehicle in our list of materials or equipment that we would use to get down the right-of-way wasn't meant to suggest that in each and every case that the air cushion vehicle would be used. That is that each of these different types of equipment has specific proper applications, and should it be necessary to cross obstacles that are too high for the normal air cushion vehicle, then we would just have to use one of the other means.

Q All right. Now, on the subject of these vehicles, the ones that I have seen have been very noisy. Is this a comment that can be generally applied to air cushioned vehicles, or are there some very quiet ones?

A I guess "very noisy" is a relative term, but I would agree with you the only one that I saw operate was what I would call very noisy. Yes Sir.

Q Yes. Do you know whether or not the company is making any efforts to make them less noisy, as I understand possibly if they were used in sensitive areas with wildlife, they might have at least a frightening effect?

A Sir, while I'm digging out the paper I'm looking for here, so far as frightening wildlife is concerned, the one comment I can make is that when the Voyageur that is constructed by Bell Aero Space was being tested actually in the north, the effect of the noise on wildlife was being noted by the people who were actually testing the thing and the effect varied quite considerably from -- and this is just recollection -- from birds perhaps being, flying up out of a slough, perhaps a quarter of a mile away on some occasions, to other birds being, just totally ignoring it. As a matter of fact, they related one instance where one particular bird was run over three times. He just got tired of flying away from the thing so he sat there, and the air cushioned vehicle overflew him. When it passed by he got up and shook himself off and went back and sat again, and three times he sat there and let the machine run over him with no apparent damage whatsoever, until he just got tired of it all. So I don't think that you can generalize in this respect.

Q I take it his hearing wasn't checked?

(LAUGHTER)

A However, so far as work

is being done in the development area of air cushion vehicles, let me mention to you that while these are vehicles that are in use today, and there are several in use in the north today, particularly by Northern Transportation, the National Research Council of Canada, in conjunction with the Canadian Aeronautics & Space Institute, and the Department of Industry, Trade & Commerce, has sponsored a group they call the Associate Committee on Air Cushion Technology, and this is actually a working group intended to take air cushion technology from the place it is today to make it even more useful to the people who will want to use the thing, and they have formed a series of working committees, working groups, they call them, who are formed from people in industry and in government, to try to develop some of these things, and just to give you an idea what it is they're talking about, there's a working group on cushioned air system parametric assessment rigs. I can't translate that for you. There is also a working group on the Toad Raft project. There's a working group on control and guidance. There's a working group on noise and propulsion in air cushion vehicles. There's a working group on air cushion pressures on highways and roads. I noted in here, for example, that as they develop different air cushion vehicles, these are being tested and they point out, for example, -- well, I'll just read one paragraph:

"The More sophistocated types can be fitted with propellers or other self-propulsion units and

"carry 25-ton loads at 50 miles an hour."

That must be the Voyageur they're referring to.

"Current vehicles under test carry up to 70 tons, a 125-ton unit is in service, and a 3,000-ton unit is in the design stage."

So there's quite a little bit of work being done on this technology, and lastly,

"The air cushion vehicle need not be used in isolation,"

and by that I mean the idea of using an air cushion assist/ on other types of vehicles is also being tested by others. You can take, for example, a fully loaded highway truck and put an air cushion assist on the thing and perhaps get the effect of half-loads during road ban purposes, and things like this, so there are a multitude of different ways that different vehicles can be applied and adapted towards the vehicles that we will want to use during the O. & M. phase.

Q I take it you couldn't do the latter without melting your snow road. That is running trucks with air cushion assists on a snow road.

A I don't think that would melt the snow road. The air that's blown down is ambient air, so if it's cold enough to support a snow road, it would just move the air from above the vehicle to below the vehicle. It may well do the road some good.

Q Now, on operation and maintenance in general, have you gentlemen considered

the special problems of the operation and maintenance of that portion of the pipeline that would cross Shallow Bay should the cross-delta route be the one that is formally applied for by Arctic Gas?

WITNESS HURD: Yes, sir, we have. Probably the one most positive evidence of that is that we recognize that repairs in that area would take longer, and for that reason the design proposes dual crossings of Shallow Bay and other channel crossings.

Q How would you inspect this crossing, Mr. Hurd? Would you use divers or equipment that took photographs of the installation from time to time, or what sort of method would you envisage using?

A To the extent expection is required, which of course is very much less than in the case of a line buried under the -- under dry ground, divers are very commonly used, yes, and I understand that there is equipment available that will take photographs under water, but I am not familiar with that.

Q Has anything been done to figure out how a diver can see or a photograph can be taken in the muddy water that comes out into Shallow Bay?

A No, I am not aware of any work that our group has done on that. I think the point is that the problems that confront you relating to a pipeline buried underground don't exist under water. For example, there is not an erosion problem and a surface vegetation maintenance problem, so inspection isn't necessary anywhere near to the extent or if at all.

Q Would you contemplate either ice scouring or the ice freezing right to the bottom of Shallow Bay and coming loose in the springtime as being something that would cause operation and maintenance people some worry and work?

A No, sir, ice related scour, the type caused by ice jams in other parts of the Mackenzie River system is not something that is likely to happen at that end of the delta. The river gradient is very, very low, so ice jams don't occur there in the same way that they do on the river before

the delta. The type of ice scour caused by ice moving in from the Beaufort Sea again seems not to be a problem because the ice does not move in that far. I have not heard of discussions about freezing to the bottom and then the ice lifting up, but that does not sound as though it would be harmful to the pipeline in any way if it did freeze to the bottom.

Q Now, have you done operation and maintenance studies in the event that the right-of-way that is applied for and granted is an offshore right-of-way and can you tell us if you have if there are any special problems that you have to deal with with offshore facilities?

A We have not spent a lot of time considering that one, Mr. Bayly. An offshore routing and I assume you are talking along the Yukon coast?

Q Yes, it is the one Mr. Dau was referring to in the last panel as a possibility using linked barges to lay the pipe several miles offshore.

A Yes. We have not spent a lot of time on that one. It is not our preferred route. But if the line was offshore, again, I suppose the same remarks would apply that -- mostly, would apply that we made with respect to the Shallow Bay crossing. Inspection is less required than it is for a line that is buried under dry ground.

Q Have you contemplated ice being a problem in that sort of an installation, that is,

ice from the Beaufort Sea?

A We are aware that if you go far enough offshore, beyond the barrier islands, barrier reefs, islands, that there could be ice gouging from ice coming in from the Beaufort Sea and that is one of the reasons that we are not enthusiastic about the offshore route.

Q So you would see that as being enough of a problem to discourage that as a preferred route?

A that is one of the several reasons, yes, sir.

MR. BAYLY: Thank you, gentlemen, I have no further questions.

MR. MARSHALL: Mr. Commissioner, you asked the other day that we file as exhibits, two reports pertaining to the Russian trip of Mr. Fielder and they have been marked as exhibits 124 and 125. ONe was his own report and the other was the draft report prepared by the Government. Mr. Fielder has given me a copy of the final report as prepared by the Government and would like to file that then in accordance with your direction.

THE COMMISSIONER: Yes, thank you, Mr. Marshall. Please do.

(GOVERNMENT REPORT MARKED AS EXHIBIT 126)

MR. BELL: It appears, sir, that all of the aspects of operations and maintenance upon which I would like to cross-examine have been deferred to the socio-economic phase, although I am

tempted to ask Mr. Fielder if while he was in the Soviet Union if he managed to pick up any information concerning the manner in which Native claims have been dealt with in that country. But I will resist the temptation.

THE COMMISSIONER: That might be a sword that cuts more than one way. You might be wise not to ask a question like that.

MR. BELL:: Well, I will resist asking that question and pass the ball to Mr. Scott.

MR. SCOTT: Miss Hutchinson just told me that coffee is ready. Would you like to --

THE COMMISSIONER: Well, how long do you think you will be?

MR. SCOTT: Two or three hours.

THE COMMISSIONER: Well, why don't -- that coffee will stay warm, I think, why don't we carry on for a little while and then we can enjoy our coffee even more than we would now.

CROSS-EXAMINATION BY MR. SCOTT:

Q Mr. Fielder, yesterday you answered some questions for the Commissioner about what might be learnt from the experience of the Russians and I think I understood your evidence to be that the decision having been made in Canada to go to a chilled,buried pipeline, there really was not all that much to learn from the Russian experience because of the view that -- or the policy that the Canadian company had adopted.

A Certainly, the manner in which the Soviet pipelines are being designed and built, Mr. Scott, are different from ours.

Q Yes.

A So far as the effects of a chilled gas line is concerned, I mentioned that I thought we had done our home work pretty well in that respect and that in a nuts or bolts or a mechanical sense there was little in my estimation to be learned in Russia.

Q But I take it that if the policy of Arctic Gas had been, as it was not, but if its policy had been to go to an above ground system, there would have been something useful to learn from observing the way the Soviets had constructed their system.

A Perhaps, as I said yesterday, Mr. Scott, my inclination is to think that we would learn a great deal more from the Alyeska experience than from the Russian experience. The reason being that the Russians have not put any large diameter lines above ground. It is inferred that should we -- if we decided not to refrigerate our line it would have had to have been above ground, that is the berm would not have worked, couldn't have been on ground, it would have to be above ground. Okay, the Soviets have not put any large pipelines on piles. Further, they don't test their lines hydrostatically and hence the pile loadings don't have to take the extra mass of liquids during the testing

period, whereas Alyeska are facing both of these problems and as well across the North Slope of Alaska facing the same types of terrain conditions that we would face in Canada.

Q I take it, however, that the Russians have a good deal of experience with river crossings and ice jams in northbound rivers?

A River crossings, certainly, but I don't believe ice jams, Mr. Scott.

Q Yes,

A They were asked once whether or not they experienced any ice jams and then we explained what we meant by an ice jam on the Mackenzie River and on their river Ob and they said, no, that that was not a problem.

Q Well, has it not been their practice, perhaps bourne of experience to avoid crossing locations where ice jams occur?

A As I understood it ice jams do not occur anywhere on their river Ob and hence that was not a consideration when they selected the river crossing location.

Q I noticed that somewhere in the report, either your report or the department's report, reference is made to a line where the river is not only twinned but where there are six pipes that run across the river.

A Yes, sir, that is quite correct.

Q I take it that that is a technique that the Russians have developed for crossing at particularly difficult crossings?

A If you will accept an opinion on this, Mr. Scott, firstly I don't think I'd say that the Russians developed that technique. It's quite common, and I can only give you the opinion that they do so for the same reason that we would want to do so. In other words, what we consider to be cheap insurance.

Q Is there not something to be learned from the Russian experience in that area, for example you've told us that they don't appear to have any problems with ice jams, a problem that is going to be difficult in our case; but yet they have gone in at least one case to laying six lines across one crossing, rather than one. Is there not something to observe or learn from examining the studies and the rationale for that approach?

A Once again, my opinion is that it's the same rationale or the same approach that is used in Canada and United States by any pipeline company who elects to twin a pipeline crossing, sir.

Q Well, why do the Russians have six lines at this river crossing rather than two?

A I can't answer that. Once again, a guess is that it was probably easier to install smaller -- six smaller crossings than perhaps two or three larger crossings on a river the size of the Yenesie, I believe, was the river that was being referred to.

Q It might also be safer, might it not? You then have to have six breaks rather than one or two.

A Before you're out of business, certainly. Yes sir.

Q Do you think there is not something to be learned from further studies of that experience?

A Sir, I don't know what that would be.

Q All right. Well now, I take it that while most - almost all of the Russian line is above ground, as you've told us, there is some local basis and some local experience with buried pipelines where the gas is carried below freezing temperature.

A No sir.

Q I understood from the report, I think on part of the Yakutsk line is in fact buried in the first place.

A I believe the report said that it wasn't on piles and left it to your imagination as to whether it was buried or not, sir. Excuse me just a moment and I'll just check that.

THE COMMISSIONER: There was a question mark, I think, about that.

A Yes, it says,

"The distance between Taas-Tumus and Pokrovsk is 356 km. and 193 km. of that length was laid above ground on supports."

Now, I don't have any idea whether the balance was buried or bermed, sir.

Q Yes. If it was buried and the gas was in fact below freezing, that would be something that would be useful to know, if it were so.

A Except that I can tell you without any doubt that the gas was not below freezing. I was told by the Russians that they have not installed any sub-freezing gas pipelines.

Q Are you saying with assurance that there is no gas carried in the Soviet Union at temperatures below freezing, as far as you understand?

MR. MARSHALL: Surely that goes much too far. He can only report on what he has seen and what he has been told and what he's heard, and he's described the limits on the trips that he's made to the Soviet Union. They hadn't seen everything that's there. Surely he can't answer that type of question.

MR. SCOTT: He was telling me what he was told. I'm content with that. He can't know anything more than that.

Q Do you understand that there is no gas -- is that your information that there is no gas carried at below freezing temperatures?

A Yes sir. Certainly artificially cooled. I guess there might be a possibility through the expansion of gas in the pipeline that in some short distance in a section of a station that some gas might get that cold, but it would not

be by design, it would be by accident.

Q But you would agree with me, would you not, Mr. Fielder, that if in fact there were lengths of buried pipe in which gas was carried that was below freezing, that would be something useful to see from the point of view of this application, from the point of view of Arctic Gas.

A Oh, I'm not sure that I agree with the word "see", sir. It would certainly be useful to study if there was a long section of below freezing gas pipeline and we could monitor it with thermal equipment, it would be very, very worthwhile; but as the Russians seem to want to come to Sans Sault to learn that themselves, I just doubt very much that it's the case.

Q Well, anything longer than 80 feet would be something you haven't seen so far.

A No sir, that's not correct.

Q I'm sorry.

A Prudhoe Bay is 2,000 feet long, and the loops at Sans Sault are in that general order.

Q I was referring to frost heave and problems associated with that.

A So was I, sir.

Q All right. Well now, is there anything to be learned from the amount of geo-technical and soils work that the Soviets do in order to get information for geotechnical design and location?

A Sir, let me quote you two sentences from my report, and then I'll explain why I'm saying it.

"The careful reader will note that information given to us in one place did not always agree with that given to us in another area. I make no attempt to referee."

Now what I meant by that was that when we visited the Design and Research Institutes in European Russia, that's in Moscow, Unesk, and indeed in Tuymen, we -- I specifically asked questions regarding how they go about learning what the soils conditions are like. If you give me a moment I'd like to read you the specific question that was posed to them. It reads like this:

"To what extent is non-destructive sub-surface analytical work carried out?"

That is, do they utilize seismic, electro-magnetic, gravity,resistivity surveys, and these sorts of techniques to locate sub-surface inclusions of free ice boulders, etc? This question was first posed in Moscow, and the response was:

"Non-destructive sub-surface analysis is not utilized. Instead, soil drilling and boring is carried out, but by another organization."

And then it goes on beyond that. The same question was posed to another Ministry in another city, and the response was that they use all of those different techniques and they all work so well they're not sure

which is best. In Nadym in the field they said, "If we want to know what's below ground, we drill holes." So all I'm trying to point out to you, sir, is that while the conversations might well be useful, my own impression is that to repeat the sort of discussion doesn't gain us a great deal.

Q Yes. I take it that the report reveals that somebody indicated to you that they drill every 25 meters along the route of the proposed pipeline.

A I don't recall that number, sir, but I'll sure accept it. It's something very close.

Q Yes, and I take it that that is substantially more drilling than the Mackenzie Highway people, for example, have been doing.

A I believe that to be true as well, sir.

Q Do you think there's anything to be learned from their judgment about the desirability of doing that?

A Sir, their rationale for that drilling, I think is different from ours. That is what they are trying to do, except once again this is my opinion, is that what they're wanting to do is to get the pipeline off of piles and back onto the ground as much as they possibly can to keep the costs down. Our reason for drilling would be quite different from that.

Q Mr. Hurd, can I turn now

to some questions related to line and station startup? I gather from the description of the line and station purge and startup that's contained in Section 13, that the startup process, both with respect to the line and with respect to the station would involve considerable air traffic along the line, and in and out of the various facilities.

WITNESS HURD: There would be more air traffic during that period, yes.

Q Is there any ball park figure you can give us as to the volume of that traffic at purge and startup time on any given location?

A I can imagine more than one flight per day for those sections which are being purged and pressured up.

Q Is that a flight in and a flight out? Is that what you mean by one flight?

A Yes, a flight along that pipeline section.

Q I see, and in what sort of aircraft?

A Mostly smaller ones which would be used to carry personnel, and they would be helicopters or the light personnel, two or three-passenger aircraft.

Q And I take it, and perhaps it's obvious, that difficulties in the purging and startup process are likely to increase rather than decrease that number of flights.

A If there are difficulties

there may need to be more flights.

Q Well now, what length of pipe are you going to purge as a unit?

A Most probably the section between stations.

Q The entire section between the stations?

A Yes, would be purged and then the next section between the next to stations would be purged.

Q And where in the section is the air going to be vented?

A At the bottom end, the end opposite from that which the gas is put in.

Q And how long is this whole process of purging the line for one section, how long is it likely to take?

A Oh, it's a matter of an hour or two.

Q You get set up and then you purge. That takes about an hour, is that correct?

A Purging is only one of several operations involved.

Q How long does the whole operation take?

A Oh, for a single section, a few days.

Q Yes, and is there any unusual noise associated with this process, particularly with venting?

A There is a noise associated with blowing off of the air at the bottom end of the system. It's not especially loud because the purge is done at low pressure. Its purpose is to displace the air that's in the pipeline with gas, and most often there is rubber sphere put in that maintains seperation between the two, and it's pushed through by gas.

Q What level is the noise from venting?

A I don't know how to answer, Mr. Scott. I don't know the level in decibels.

Q Well, perhaps Mr. Marshall can find that out. Would that information be readily available?

A It could be calculated.

Q Are there any plans or indeed any capacity to muffle those noises associated with purging?

A Yes, there are attachments that can be put on blow-down stacks that will muffle the sound.

Q Are they going to be utilized on this project?

A We have considered using them. Not in the purge operation because since it takes place at low pressure the noise is at a relatively low level. If a section of the line which was operating at its full operating pressure needed to be vented, that is a much larger noise and in that context we have considered the use of those devices.

Q Are there similar levels of noise associated with the start up and testing of the compressor station itself?

A Yes, for much shorter periods of time, but during the start up operation it is often necessary to blow the pressure down from the station piping and it starts at the same pressure and for a few minutes it is quite loud, but the station piping is a much smaller volume of gas and it blows off much more quickly.

Q Well, now, I take it that the purging and the start up process is going to -- is going to begin when sections of the line get completed, is that correct, or is it all going to begin at once when the line -- just before the line goes into operation?

A I don't know that we can be too detailed on that, nor do we need to be. We can be quite flexible. It is likely that construction would move on past several stations. Perhaps on the lateral up to Richard's Island it would be completed right to Richard's Island and at that point then gas which is available from Richard's Island would be

used to purge the line moving south.

Q I see, so it is contemplated, is it, generally, that this will be something that will follow along behind the completed construction stages?

A Follow shortly or some time later, yes. There is lots of flexibility in that.

Q Yes, obviously there are engineering and logistical factors involved in deciding when this should be done, are you going to obtain any environmental input as to the propriety of doing it at particular locations at particular times?

A Yes, sir.

Q From whom are you going to obtain that input?

A The -- probably the first people we would turn to are the consultants who are now consulting to the company.

Q Yes.

A Who are most familiar with that area.

Q And I take it that there is no reason, bearing in mind the flexibility that you earlier described why you should not be able to submit to their suggestions about timing for local section purging and compressor station purging.

A That would be one of the considerations that we would take into account. Now, as you mentioned earlier, there are other considerations

that must be taken into account also.

Q Yes.

A Because of the flexibility in the timing of that operation we see no special problem in reflecting their recommendations.

Q Yes, I take it that -- or let me ask you, are you also going to consult with the people who live in the communities to determine what is the appropriate time for purging and compressor station start up, bearing in mind the effect it may have on their communities?

A Yes, Mr. Scott, I think as a general rule, any pipeline operation that might be of concern to people in a community, assuming that they are close enough, would cause us to consult with the people in that community.

Q Yes, it can be all quite alarming if you are not expecting it, I presume?

A The blow down of a high pressure line is quite noisy and if you are not aware of what it is it can be alarming, yes.

Q Now, are there likely to be the same sort of unusual noises associated with a compressor shut down --

A Yes.

Q -- and start up again in the course of routine maintenance?

A Yes, normally, a compressor unit shutdown includes closing of the -- what is called the unit valves, which isolates that unit from the

balance of the station piping and the blowing down of the gas on the compressor side of those unit valves. Now, that is a much smaller volume than we talked about earlier as being contained in the station piping. If the whole station is shut down then all of the station piping is blown down. Both -- either of those operations last only for a very few minutes.

Q And bearing in mind that this is routine maintenance I am talking about now, I take it that you will again be able to get environmental advice and will have some flexibility about timing when it will occur at any given location?

A That is correct.

Q Yes, now, I take it the same noises and so on are associated with emergency shut down?

A Yes.

Q But I take it by definition it is not possible to time when those events will occur?

A That is correct.

Q Yes. So, generally speaking, would it be fair to say, Mr. Hurd, with respect to start up and routine management, that you will have to take care of emergencies when they occur but that apart from emergencies you can -- you have sufficient flexibility that in -- if not in all cases, in many cases you will be able to defer to local or environmental advice as to timing?

A That is correct, yes.

Q Well, let me ask some questions now about patrol of the line. Before doing that I would like to point out to my friend, Mr. Marshall that in the transcript on page 5054 and 5055 he undertook to obtain certain information regarding the maintenance flights. I was going to say the overview flights, but that could be misunderstood. I would just like to be sure that for the purposes of the record, the information that we requested is clear. I wonder if he could obtain for us order of magnitude figures on the number of flights, of the different kinds of aircraft, that is, large transport planes, STOL aircraft or helicopters on a typical construction spread during a typical month in the main construction season. In the second place, the same data for the peak month during the proceeding summer season, and thirdly, the same data for the peak month during the preceding winter both on the same construction spread. Do I understand, Mr. Hurd, that those figures could be devised. I recognize that they would be ballpark figures to a certain extent, but that they could be devised?

A I can speculate, I guess, on what the construction people might come up with. My impression is that they could make ballpark estimates, yes.

Q Well, now, turning to the frequency of flights during the operation and maintenance phase I gather from Section 13-B that during normal operation there will be one to three maintenance flights

per week to compressor stations, is that correct?

A Yes.

Q And that those flights will normally involve cargo helicopters or STOL aircraft?

A Yes.

Q In addition to that there will be line patrol flights once a month generally and as frequently as once a week in the spring and at other times that are judged to be critical?

A Yes, that is right.

Q And those flights will originate and end up where, at the divisional headquarters?

A At the district headquarters for the district that is being patroled.

Q Well, now, is it likely that in routine circumstances there will be regular flights in addition to the ones that I have described or have I covered them all?

A There could conceivably be other flights for other reasons, compared to the two categories you mentioned they would be very infrequent.

Q Well, let me ask this, for example, is the routine maintenance work that is required to be done from time to time either at the station or on the line likely to be serviced by the one to three flights a week, or will that require additional flights?

A No, the routine maintenance work we expect will be covered by those one to three flights per week.

Q Is there going to be -- perhaps it's obvious -- a lesser frequency if the compressor station isn't being utilized or has not commenced operations?

A There would be a lesser frequency, yes.

Q Now in -- on pages 13 and 14 of Section 13-B, it is stated that the flights will be authorized or supervised by the applicant's district supervisory personnel. Now, is this principle going to apply to all flights that occur on behalf of the applicant, whether the aircraft are owned by the applicant or rented, or whether the service is contracted for?

A All flights within that district, yes sir.

Q And that is so even if Arctic Gas buys a service from some other independent contractor?

A Yes.

Q Now, how is this authorization or supervision going to be carried out?

A You mean in a mechanical sense, Mr. Scott?

Q Well, for example, if I am a -- if I operate a service out of Yellowknife and Arctic Gas hires me to do certain work in the way of transportation, let us say, when does the supervision begin? Let me put the example this way. If I am hired by Arctic Gas to make a delivery, presumably I'm told where I'm to pick up the goods and where I'm to deliver

them. Is there going to be any other control, apart from that? Am I going to be told when I may fly and at what height I may fly, and over what areas I may not fly, and so forth?

A Yes indeed.

Q Yes, and does that apply to the whole flight, or simply the flight as it covers the pipeline right-of-way?

A To the whole flight.

Q And are you going to make this a contractual arrangement between yourself and others whose services you buy for aircraft?

A Yes. Typically the arrangement worked out with a charter company would specify things like an aircraft must be available for scheduled line patrol flights which can be precise, and for -- if the same company provides the larger aircraft -- for the maintenance flights, those requirements would be set out with the schedule as accurately as you can at the time that you contract. The requirement would be that the charter company have aircraft available to fly under the direction and according to the scheduling set out by the pipeline company.

Q The thing that troubles me is I quite understand how you can authorize and supervise planes that you own and planes that you man and direct yourselves; but if for example you ask an independent contractor to make a delivery from Fort Norman to compressor station XYZ, next week, is it truly your intention to tell him at what height he

must fly, over what areas he may not fly because of a bird population, what route he must take, what hours of the day he must fly that particular delivery, and so on?

A Yes, I can imagine that we'd be that detailed and probably more so, and we might add that it would be unlikely to ask a charter aircraft company to deliver a certain thing, or infrequent to ask a company to deliver a certain thing to a certain location unless there was an employee of the operating company going with him. We would make every effort to minimize the flights for our own interests because of expenses, so he would carry as a passenger a member of the operating company.

Q Is that going to be routine that a member of the applicant's company will accompany these independent contractors for flights?

A It would be so frequent as to allow us to call it routine, I think. There may be occasions where a spare part would need to be delivered from Division Headquarters or District Headquarters to a station, as you described earlier. That would be a very infrequent situation. Most often there would be a need to carry people along as well. Those people would be the pipeline company's employees.

Q Well, what I'm concerned about is apart from entering into a contract with these independent contractors to provide the service, how are you going to police that they comply with your environmental requirements as to flight times, heights, places,

and so forth?

A It would be a condition of the agreement that we enter into with the charter company and as I mentioned earlier, the great majority of flights would carry a passenger who is an employee of the pipeline company.

Q And I take it that the employee you're going to carry is a person who will have authority to control this independent aircraft? Independent contractor.

A Yes.

Q All right. Well now in Section 14, this is just a point that I don't understand, you state that:

"Float-equipped aircraft will not be used during any phase of pipeline activity."

Is my understanding correct that you don't intend to use float equipped aircraft at all?

A I'm not aware of that, Mr. Scott. Your reference was which?

Q It's Section 14, BN-7,8.1, 7.8.1, at page 39. Got that?

THE COMMISSIONER: Got that? I think we'll adjourn for coffee.

(PROCEEDINGS ADJOURNED FOR FEW MINUTES)

(PROCEEDINGS RESUMED PURSUANT TO ADJOURNMENT)

THE COMMISSIONER: I think we had better /wait for counsel for Arctic Gas.

Mr. Scott, before you start, I said yesterday that I would give the parties my ruling on the motion made by the Canadian Arctic Resources Committee about taking evidence regarding alternate routes. Canadian Arctic Resources Committee has urged the Inquiry to take evidence regarding the whole question of alternate routes for the proposed gas pipeline right after phase one of the formal hearing is concluded. The formal hearings are divided into four phases. Phase one, engineering and construction of the proposed pipeline. Phase two, the impact of a pipeline and Mackenzie corridor development on the physical environment. Phase three, the impact of a pipeline and Mackenzie corridor development on the living environment. Phase four, the impact of a pipeline and Mackenzie corridor development on the human environment.

The Government of Canada in establishing the pipeline guidelines proceeded on the assumption that there would be two pipelines from the Arctic, an oil pipeline and a gas pipeline. At one time it was felt that an oil pipeline would likely come first and then a gas pipeline. Now it appears that a gas pipeline will likely come first and that if it is built it will be followed by an oil pipeline. The pipeline guidelines contemplated a transportation corridor that in the short run will likely

include a gas pipeline and an oil pipeline and that might in the long run include a highway, a railroad and electric power transmission line . The assumption is that the route that is chosen for the gas pipeline will be chosen for the oil pipeline too. Thus the route chosen for the gas pipeline will become a transportation corridor, so any discussion of alternate routes is inevitably a discussion of alternate corridors.

The pipeline guidelines require Arctic Gas to file a comparison of the proposed route of the gas pipeline with alternate pipeline routes. Arctic Gas has filed evidence relating to alternate routes. We have already had some cross-examination directed to the members of the panel on route selection on the subject. Arctic Gas wants to build its pipeline along the prime route.

The prime route runs directly east from Prudhoe Bay along the North Slope of Alaska and then along the north coast of the Yukon and the Northwest Territories swinging south around the Mackenzie Delta and then east to Travaillant Lake.

The interior route which is the alternate route to the prime route along the coast proceeds southeasterly from Prudhoe Bay, across the coastal plain and then through the Brooks Mountain range of Alaska. Then it brings the pipeline to the international boundary by Old Crow Flats and then through the Richardson Mountains into the Northwest

Territories and on to Travaillant Lake. The interior route would avoid the Arctic National Wildlife Range in Alaska and the narrow coastal plain of the Yukon, but it runs along the south edge of the Old Crow Flats.

The other alternate routes appear to be the offshore route, which would mean an underwater gas pipeline from Prudhoe Bay along the Arctic Coast to the Alaska-Yukon border. From there it would proceed on the prime route along the north coast of the Yukon and the Northwest Territories, swinging around the Mackenzie Delta and then east to Travaillant Lake. This route and the other alternates would avoid the Arctic National Wildlife Range in Alaska.

The Fairbanks route would bring the pipeline south from Prudhoe Bay through the Brooks Mountain Range to Fairbanks parallelling the Trans - Alaska Pipeline, then along the route of the Alaska Highway to Whitehorse. The supply line bringing gas from the Mackenzie Delta would travel south along the proposed route of the Dempster Highway to Dawson and then to Whitehorse. The Trunkline would travel southeasterly along the route of the Alaska Highway through British Columbia and Alberta.

The Fort Yukon route would bring the line south to Oksrukyik swinging southeast to Fort Yukon in Alaska and then along the Yukon River to Dawson where the supply line from the Delta would join it. The trunkline would travel south

to Pelly crossing and Watson Lake and then along the route of the Alaska Highway to B.C. and Alberta. Both the Fairbanks route and the Fort Yukon route would, from milepost 282 in Alberta, travel along the prime route to Caroline, Alberta.

The edge of the shield route, the INquiry has received submissions urging that the pipeline should travel along the -- from the Mackenzie Delta along the edge of the Canadian Shield, across the Barrens, through Manitoba and Ontario.

I think it is sound to take evidence on alternate routes at the end of phase one. The four phases of the Inquiry are not meant to be like watertight compartments. We have adopted them to enable us to proceed in an orderly way. In phase one which is now coming toward its end we are trying to find out how Arctic Gas intends to go about building the proposed gas pipeline. In phases two, three and four, we will be seeking to determine the impact of the pipeline and all its ramifications upon the physical environment, the living environment and the human environment. Then we can establish the terms and conditions that ought to be laid down in respect of any right-of-way that might be granted.

I think that we should hear this evidence about alternate routes in Whitehorse. The people in Old Crow want to have a chance to discuss these routes and the Inquiry is holding a community hearing there beginning July 10th. But people throughout the Yukon may wish to have a

chance to discuss these various alternate routes, so we will hold a hearing at Whitehorse the week of August 11th and if necessary, the week of August 18th as well.

Arctic Gas should be prepared to call witnesses at Whitehorse to discuss the reasons why a comparison of these routes led to the adoption of the prime route and the rejection of the others. The Canadian Arctic Resources Committee says it is prepared to call evidence relating to the whole question of alternate routes. We will hear that evidence at Whitehorse. The counsel for Yukon Indians and any other participant that wants to will be entitled to call evidence on alternate routes at Whitehorse, too.

We will also take evidence at Whitehorse relating to supply routes through the Yukon. Even if the prime route is finally approved it may be that equipment and material will have to be shipped via Skagway to Whitehorse and over the Dempster Highway to build the Prudhoe Bay supply line.

Arctic Gas in its construction plan filed on March 21st, 1974, declared that if it required to follow the interior route, some of the pipe for the Prudhoe Bay supply line might be moved through Skagway and Whitehorse.

The Inquiry has been told that the Arctic Gas project is the greatest venture ever undertaken by private enterprise in terms of capital expenditure. The quantities of equipment, materials and supplies required will be enormous. 1.9 million tons of material will be transported into Canada north of 60. Pipe is the largest component by tonnage. In 1978, 409,000 tons of pipe would be brought in; in 1979, 476,000 tons of pipe; in 1980, 213,000 tons of pipe, a total of 1.1 million tons of pipe. So the question, "By what route or routes, is it all going to be transported to the site of construction?" is very important.

The assumption by Arctic Gas has so far been that the steel pipe for the pipeline would be manufactured in Canada by Stelco and moved by rail from Welland to Hay River and then barged down the Mackenzie River. But Arctic Gas has nevertheless been in touch with pipe mills in many countries, including Japan. It may be significant that all of the pipe for the Alyeska Pipeline was supplied by Japanese Steel Mills. If the pipe for the Arctic Gas line were, even in part, to be obtained from the same source, one of the possible routes for moving the pipe would be by sea to Skagway, then by rail to Whitehorse and then by truck over the Dempster Highway to Fort McPherson. If the pipe were to originate in Japan, four routes to bring it to the north coast would have to be considered.

One would be to ship the pipe

directly from Japan through the Bering Strait around Point Barrow and along the North Coast to the Mackenzie Delta.

Another would be to ship the pipe to Vancouver and then barge it north to the Bering Strait and around Point Barrow.

Another would be to ship the pipe to Vancouver and then move it by rail to Hay River.

The other would, of course, be to ship the pipe to Skagway to Whitehorse, and over the Dempster.

The question whether the Dempster is used depends on whether the pipe originates off-shore and on the tariffs likely to be charged by carriers over the Dempster. All of this is, of course, dependent upon the prime route or the interior route being approved. If the route over which the pipeline were built was the Fairbanks route, or the Fort Yukon route, it would follow that vast quantities of equipment and materials would be moved into the Yukon. The Inquiry is holding most of its formal hearings in Yellowknife.

We are also holding hearings in each community likely to be affected if the pipeline is built. If it is built, it will affect the people in the Yukon as well as the people in the Northwest Territories. So I will be quite prepared when the Inquiry is in Whitehorse to hear the views of any person or organization that wants to discuss any matter relating to the building of the proposed gas pipeline. The hearing in Whitehorse

then is to consider alternate routes, supply routes, and any other matters related to the proposed pipeline will commence in Whitehorse Monday, August 11th, at 10 A.M. We will be well into Phase 2 by then, but that is the earliest convenient time to hear the evidence at Whitehorse. We will not deal at Whitehorse with the question of the corridor concept itself, including the impact of an oil pipeline. We will deal with those matters later on.

So carry on, Mr. Scott.

MR. SCOTT: Q Mr. Hurd, perhaps Mr. Marshall put before you the section 14 at page 39 which I referred to. I refer you to that because it states, I think, clearly that float-equipped aircraft will not be used during any phase of pipeline activity. Is that the position of the applicant, as you understand it?

WITNESS HURD: Mr. Scott, the statement that you referred to is in one of two paragraphs under the heading,

"Water Fowl on North Slope Lakes."

In that context, I think we can talk about the operations and maintenance concepts, we do not feel qualified to talk about the construction aspects at this time but with respect to operations and maintenance --

Q Yes, I just intended to ask you about the use of this kind of aircraft in operations and maintenance.

A Fine, and with respect to the North Slope lakes, we can confirm that it is not

the company's intention to use float planes in that area. The operations will have to be organized in such a way that they can carry on through the winter season, which is of course the major part of the year. So the company will need to be equipped with aircraft that, besides helicopters, which of course do not require lakes, with fixed wing aircraft which have wheels or skis for a winter operation, and those same aircraft would be used during the summertime. So it's not our intention to use float-equipped aircraft in that area. We should elaborate a little, however, with respect to other areas along the pipeline, for example along the Mackenzie River we can well imagine situations where float equipped aircraft would be perfectly practical aircraft to charter, for example, to move equipment or people from one location on the river to another during times of the year when there would be no disturbance to water fowl or other wildlife.

Q So I take it then that that disclaimer should be read as if it specifically said that it applied only to northern lakes on the North Shore.

A I think that's correct, Mr. Scott. There is a lot of aircraft travel up and down the Mackenzie River now with float-equipped aircraft.

Q I raised the question because in Section 13 in another connection, the application speaks of finding location of water

bodies suitable for aircraft use and it seems to suggest a conflict, but I think you clarified it by your answer. Now, can I turn to line patrols generally? Am I correct in saying in the first few years after the pipeline goes into operation you will be patrolling by aircraft, by vehicle, or on foot, as you said this morning, not only the line but also the ancillary facilities that are connected with the line?

A The term "line patrol" applies commonly to the pipeline itself. There are other facilities that will require visits. They fall more into the category of scheduled maintenance.

Q I take it, though, that apart from maintenance visits, will you be patrolling on a routine basis such things as borrow pit areas, temporary access roads, snow roads where they exist, shoo-fly roads and things of that sort?

A Yes, they would be inspected on a scheduled basis, if there was any risk that for example thermal degradation might cause erosion.

Q So that I take it that we may expect that as a matter of operational routine these other facilities, as well as the line itself, will be regularly patrolled on some schedule that the company develops.

A Yes. As I said, wherever there's some risk that some degradation might occur that would need to be checked, yes.

Q And I take it that again the same three general modes of inspection --

aircraft, small vehicle, and on foot patrol -- will be utilized from place to place.

A That's correct.

Q Now, in Section 13, speaking of patrol by aircraft, the application indic-cates that the ideal flying height is 100 to 100 feet. Has any consideration been given to the possibility of -- or the risk inherent in conducting your patrol at a higher elevation coming down when necessary to inspect specific problems that you may have detected?

A If you mean the risk of disruption of wildlife, yes sir, it has. The elevation of 500 feet or perhaps higher, in cases where distur-bance is a serious risk, I'm sorry, let me start again. The risk of disturbance for example to birds which are staging is much higher if we fly at the lower altitude, and for that reason we've said that in those cases flights could be made at a higher altitude, and at a lower altitude only when it was necessary in those rare occasions to come down and inspect something more carefully.

Q Well, yesterday you indicated that at least with respect to the snow geese and perhaps with respect to other dramatic environmental events, such as caribou herds and so on, that you could alter the elevation. I'm really asking you a more general question now. Has consideration or could consideration be given to flying your patrols generally at a higher level on all occasions, recognizing the necessity to come down to a lower altitude when you

either anticipate or see particular problems?

A It would seem unnecessary, Mr. Scott, for the greater part of the year. It's conventional practice for pipeline companies to patrol the pipeline right-of-way in fixed wing aircraft at altitudes lower than at 500 feet. That's through long years of experience have been found to be the most effective altitude. During most months of the year there is no risk of disturbance to wildlife, and we think it would be desirable to fly at that altitude at those times.

Q Well, I take it when you speak of no disturbance to wildlife, you're speaking of no disturbance to what I call dramatic environmental events like calving grounds and caribou herds and snow geese ready to fly south; but I take it, for example, that aircraft flying three times a week at 100 feet, let us say, over an area, may have some effect on the ability of people to hunt and trap in that particular area. I wonder if it's not possible without any severe risk to the company's efficiency, to establish that the patrols will be flown at a higher level, recognizing that emergencies or things that you detect will oblige you to not only come lower but in many cases to land?

A The three times a week, Mr. Scott, I think we were referring there --

Q I'm sorry, yes.

A -- to maintenance.

Q Just once a week, isn't it?

A It's more often once a month for aircraft patrol of the right-of-way, and in certain seasons where after a heavy rain, for example, then more frequent flights are necessary, but even there it's less than three times a week.

It seems to us that the most desirable thing would be to fly at the lower altitude for pipeline patrol purposes, during times when disturbance is not likely to either hunting or trapping operations or wildlife --

Q I can't get any movement on that figure at all? I mean this isn't an auction, don't misunderstand me, but it might be that fears would be allayed if it could be said that these patrols will fly, let us say, at 500 or 1,000 feet, or whatever meets the reasonable demands of the company.

A I think, Mr. Scott, if we thought it would be of any real help, then certainly we would adjust the flights to that altitude which removes or minimizes the risk of disruption to wildlife and to trapping operations.

I think that what we are saying is that the majority of patrol, line patrol flights are not likely to disturb anything that is going on on the ground anyway and it is more useful and effective to fly at a lower altitude. I think that we are saying also that in those situations where disturbance is a possibility, in those occasions then we fly at the higher altitude and come down only when it is necessary, perhaps in a helicopter and approaching the line in such a way that we stay as far away as we can from staging birds, for example.

Q I take it because of your ability to do the job more or less at 1,000 feet, the elevation is not from the applicant's point of view a crucial factor?

A I think we talked about times when disturbance is a possibility of going to some 500 feet rather than the 1,000.

Q Well, your American colleagues talked of 1,000 feet apropos of the snow geese.

A With respect of snow geese, yes.

Q Well, perhaps we can leave it simply this way. It seems to me that it would be helpful if the applicant, if it is disposed to do so, could review that question to determine whether this is the -- in fact the minimum level at which they must fly. Mr. Marshall is going to say something.

MR. MARSHALL: Well, it seems to me that Mr. Hurd has said that they do not see that there is any advantage, really, to increasing the altitude other than at those times of critical importance. Perhaps, Mr. Scott, if you could be more specific -- are you going to lead some evidence at this point?

MR. SCOTT: Well, let's put it this way. If it were shown to the applicant, Mr. Hurd, that there was an advantage, generally, in requiring patrol planes to fly at 500 or 1000 feet, coming down only when necessary, I take it that in those circumstances, you would be prepared to review the matter to see whether that concern could be met and allayed.

A Yes, indeed.

Q I think, Mr. Marshall, all this is prelude to phase three.

Well, now, at what elevation are the flights into the compressor stations going to fly or do you know? Assuming Ministry of Transport approvals for your --

A Most often, Mr. Scott, much higher. There may be occasions when -- occasions in which a line patrol can be accomplished at the same time that a flight is being made into a compressor station and opportunity would be taken of all those -- advantage would be taken of all those opportunities. In that case the flight would be down at a height similar to regular line patrol altitudes, but most often

if the object is to get from one point to the station it would be at altitudes much higher than even the 500 feet.

Q Well, now, did I understand you to say to Mr. Bayly this morning that when you used ground patrols, that is, on foot patrols, they will be accompanied by helicopters?

A There could be occasions we could imagine where there is a sensitive area, perhaps a staging area, a molting area, where -- which is not too far across, in which foot patrol people could be dropped off by a helicopter at the edge of that sensitive area and those people would walk through the sensitive area and be picked up by the helicopter at the far side of it. In that sense, the helicopter would be used.

Q Yes. But I take it that one of the objectives of foot patrols will be in certain areas, places and times to avoid the environmental risk or damage that may result from aircraft and that therefore the company's policy will be/to land the foot patrollers and then to go away somewhere and pick them up later at another point.

A Yes, that is right.

Q It is not intended that the helicopters should fly over the foot patrol men?

A That would defeat the purpose of the whole exercises, right, sir.

Q So that we can say that the foot patrol is to be utilized in lieu of aircraft

inspection or vehicle inspection?

A In that case where the reason was an environmental sensitivity, there are other situations where a foot patrol might be used.

Q And are you going to take advice from time to time as to the propriety of aircraft and vehicular patrols as opposed to foot patrol, environmental advice?

A That would be a normal part of the routine, Mr. Scott, that the man responsible for dispatching the patrol aircraft would be in regular and frequent contact with biologists so that he has the advice of where sensitive areas are and in what seasons and so on.

Q Well, I take it that from what you said yesterday that there are going to be two sources for this advice, first of all will be the operations manual which will describe, I take it, regular and recurring environmental events where foot patrols or other modifications in operation may be required.

A Yes.

Q I take it a classic example will be the manual will tell you what you can orcannot do on the north shore where the snow geese are staging?

A Yes.

Q But you would agree with me also, wouldn't you, that there would be unusual or unexpected environmental events that will occur

almost at a moments notice? A sudden appearance of caribou in a place where they have never been before.

A That is a possibility, yes, sir.

Q And other events of that type?

A Yes.

Q Obviously those events -- or let me put the question more positively, I take it it will not be possible for those events to be covered by the ground rules contained in the manual.

A Except in a general way.

Q Yes.

A The operators of the patrol aircraft would be required to watch for those unusual situations.

Q Yes, but when those unusual situations occur what is going to be the source of the environmental advice that the people working in the district will have?

A I think , Mr. Scott, two sources of information, if I can rephrase it slightly. Firstly, the people who operate aircraft and who operate in those regions will receive instruction on environmental matters before they go and begin their regular work. It will be a part of the training that they receive. So they won't be ignorant of the environmental sensitivities that could occur, including the unusual ones. But secondly there are environmental

people intended to be on staff with the applicant who would be gathering information from wherever it is available. The Government Wildlife people, for example. Information available to that staff probably would come as much from our own operations as from anyone else.

Q Well, dealing, because we are here now, although I intended to deal with it later, where are these people going to be? Are they going to be in Calgary?

A Environmental people if I remember correctly are at the division headquarters.

Q Yes.

Can you tell me, perhaps not now, but can you ask Mr. Marshall to tell me the disciplines that will be represented on this on site environmental staff because you would agree with me, wouldn't you, that many of the environmental events that occur are not as straightforward as the snow goose problem but often involve competing environmental interests in which the decision to avoid an environmental event "A" may provoke or injure environmental event "B" occurring somewhere else.

A Yes.

Q and I take it that in those cases, leaving security and efficiency aside for the moment as something you have to acknowledge, the decisions that will be made will have to be made

by expert biologists and other environmentalists.

A Yes.

Q Is there going to be a staff at Calgary as well as in the district with this kind of capacity?

WITNESS FIELDER:

A As I recall it, Mr. Scott, our current plan was to have a staff -- a full staff in Calgary and a more minimal staff in the district organizations. Perhaps someone with a broad background in environmental matters who could draw upon the individual talents of those in the larger centers because we do have virtually instantaneous communication available to us.

Q Well, perhaps I can expand my request to Mr. Marshall. I would be grateful to know what the complement intention is with respect to these environmentalists both at Calgary and where they exist in the field.

MR. MARSHALL: I think we can get that for you.

MR. SCOTT: Q Dr. Fyles, just pointed out that in the chart for NOrthern Division Headquarters at Inuvik for example, it is shown that there are two persons who fall under the general heading "Engineering, Technical, Environmental, Lands and Right-of-Way".

I would presume first of all that one of those at least is going to be an engineering expert?

A Little doubt of that sir.

Q Yes. What about the other one? Have we any assurance that he will be an environmentalist or someone who will concentrate on this area of concern or interest? Or is it too early to say?

WITNESS HURD: A I think we could say this Mr. Scott, that he would be qualified to do the job that he is there to do, which to a large extent is gathering and coordinating and judging information that will come from a lot of other sources. Those other sources as I mentioned before would be current information available from the Wildlife Service, the Territories Government people, other biologists who are working in

the area, and consultants who are consulting to the pipeline company.

Q Well, I'll come to an example later, but let me illustrate for you if I can the problem that troubles me about this. Obviously when there is an Operations and Maintainence requirment the efficient engineering people want to do their work as quickly and as well as they can.

I'm looking for some authoritative voice in the Applicant that-- authoritative environmental voice that will impose reins on the natural desire of the engineer to be efficient, and say,"now, hold up here, you can't do this now". Is there going to be such a person and where is he going to be located?

A The person who makes the judgements on the importance of environmental considerations is the man you talked about. His authority comes through the Division manager who must balance off the desires of the engineer, who as you pointed out/naturally is in an hurry to repair wash-outs for example on the line, and the wishes of the environmental person that is advising him. He's going to very much concerned about looking after all of those interests, in addition to a lot of others, because the operating group means to be in business for a good long time in this area.

Q Well, what authority is he going to be given? What I'm really looking for is a kind of policeman.

A In a sense he is that. He has -- through the Division manager, he has the

authority to schedule or re-schedule all of the work that is done within that Division.

Q Well, on Panel 1 , Mr. Dau in descirbing how the route was selected told us, and I hope I don't do any injustice to him, that when they convened the environmentalists, if there was not agreement among the environmentalists as to what should be done in any eventuality, the poor engineer at the top had to make the decision essentially ignorant of the interests that were at stake. Now is the environmentalist at Inuvik for example going to be given --

MR. MARSHALL: I think that was unfair to Mr. Dau.

MR. SCOTT: I think that is precisely what he said, and I'll give the quotation to my friend later.

MR. MARSHALL: I think there is a contradiction there.

MR. SCOTT: Q Is that the situation that is going to exist at Inuvik or is this man, the environmental man going to say this maintainence job cannot be done now, and is he going to be able to make that stick?

A He will work very closely with the Division manager, whose decision it will be to go or not go on a particular job at a particular time. I think the Division manger will not be ignorant of the considerations that he must have in mind when he makes his decision.

Q But, ultimately he of

course has to decide?

A That's correct.

Q How long could routine line patrol flights be interrupted if there were a need to do so for environmental reasons? Over any given section of line?

A In the winter, it could be interrupted for a period of some months.

Q Three or four months are you talking about?

A I think that's possible. Of course the risk of environmental disruption or disturbance in the winter is much smaller.

Q How about in the other seasons?

A It's probably not possible to be specific on that one Mr. Scott. It depends on the time of year. If it's spring or summer, and if there have been heavy rains, then it's rather important to get out and see if erosion has occurred along the ditch line somewhere. So there is a pressure to move quickly and do the pipeline patrols more frequently during that time.

Q Well, do I overstate it if I suggest that in the spring, summer and autumn the routine will have to be followed barring a major environmental event? It will be a special case that will lead to the deviation from the routine?

A The routine is quite flexible in the sense that it needn't be on a particular

day. It becomes less flexible as you stretch that time out. There would be periods in the spring and summer when it would be very difficult to leave large periods of time without patrolling the line, and that is more true during the early years of operation. As time goes on and the vegetation cover takes hold again you can delay them a little longer.

Q Mr. Bayly asked you some questions about fires, and I think he covered all the ones I had to deal with, with one or two exceptions.

Is it generally speaking correct to summarize the Applicant's position with repect to on-the-line fires, that is opposed to compressor station fires, that you are not generally concerned about them. They happen and while you are not going to start any, you are not going to be worried about them?

A I think not, Mr. Scott. Our concern with respect to fires along the line is that if the vegetation layer is damaged and erosion of the underlying soil is a possiblity; we are very concerned that there not be erosion which could undermine the pipeline.

Q Well is this proposal for example, that from time to time in erosion sensitive situations that mats of several miles in dimension should be placed on the land? Is that a practical suggestion or is that just a theoretical proposal? It seems to me an incredible exercise that these mats with plastic or chicken wire covering should be placed on areas of that size?

A We don't envision Mr. Scott trying to cover several square miles, no.

Q What is the largest kind of mat that you are ever going to deploy?

A Certainly hundreds --

Q I heard someone saying campfires behind me. I presume you have a larger mat than that?

A Easiliy hundreds of square yards. We would conentrate in areas where the vegetation has been damaged on a slope for example, and erosion could occur quite quickly after that. If the area is quite flat we would hope to restore that area by seeding.

WITNESS FIELDER: If I could interject, during construction when the ditch is open Mr. Scott we'll have an excellent idea of of the ground conditions in all locations along the pipeline route, and this will give us an indication as well, or another guideline as to what measures have to be taken should a fire occur over the right-of-way, or near to the right-of-way.

Q That's the ground data chart that I think the geotechnical panel told us would be prepared mile by mile.

A As the ditch is opened.

Q Yes.

A Yes, sir, that's what I am referring to.

Q Well, for example are

you considering cutting or bulldozing any firebreaks? Either along the line, or adjacent to storage areas?

WITNESS HURD: I can't imagine where any fire breaks would be dozed. I think we've learned our lesson by the example around Inuvik of what can happen in that situation.

Q So we may take it as a matter of policy at the moment at least, that there are going to be no firebreaks in connection with this line?

A No bulldozed firebreaks We propose that at station sites which are in areas that could sustain a fire, that there would be cleared area surrounding the station pad, which is perhaps protection for the station moreso than the surrounding terrain.

Q Yes, but none of that is going to be done on the line itself, or in connection with any storage areas that may be elsewhere than at compressor stations?

A Not along the line itself. Storage areas connected with compressor stations--

Q I'm sorry, not connected with compressor stations.

A Not connected with -- Possibility that it might be done at wharf sites or pipe storage locations.

THE COMMISSIONER: What lesson did you learn at Inuvik? We've all seen the-- what happened by reason of the fire there, but what was

the lesson that you say that you have learned? I didn't quite follow that.

A Oh, nothing profound Mr. Commissioner. Only that we have seen the fire break that was bulldozed there to stop the fire, and we've seen the erosion that occurred following that bulldozing, and particularily what can happen when you bulldoze the surface mat.

MR. SCOTT:

Q Well, I want to get the sense and I may be mistaken that you underplayed the risks of a forest fire crossing the right-of-way. What are the risks that you envisage, if a forest fire crosses the right-of-way, a substantial forest fire?

A Only the one that if the surface vegetation is damaged in a sensitive permafrost area that there can be erosion following that. The pipeline itself is not endangered at all by a forest fire.

Q So you see this really as causing, if anything, an erosion and therefore perhaps a stability problem in connection with slopes.

A Yes.

Q You don't see any other consequences at the moment, either for the line or for the right-of-way?

A Not where it's a buried pipeline, there are no surface facilities, no sir.

Q Well now, could I deal with some questions that touch on the on-ground maintenance of the right-of-way, and I note that in the application you speak about on-ground maintenance from time to time, but in no place, because perhaps it's obvious, do you spell out precisely what that maintenance may involve, what kinds of maintenance may be required, and I would like to list with you a number of kinds of maintenance that may be required, and I wonder if you can tell me whether these kinds of maintenance are anticipated being done in winter or in the summer,or

both? First of all, repair of erosion scars on earth flows. I take it that that's a kind of maintenance, first of all, that may have to be done from time to time.

A We hope --

THE COMMISSIONER: Could I ask, repair of erosion scars on earth what?

MR. SCOTT: On earth flow. I shouldn't have said "on" -- or.

THE COMMISSIONER: Or earth flow.

MR. SCOTT: Where the erosion develops, or the flow, Dr. Morgenstern described it, moved out from its historical or then current position. He -- I think his evidence was that repairs might have to be done, or maintenance might have to be done to stabilize that situation.

Q Is that one of the maintenance tasks that you contemplate?

A Mr. Scott, I guess maybe I need some more clarification, too. Dr. Morgenstern talked of three types of soil movement. He talked of the skin flow, and the deep seated flow, and what he called the third as the progressing erosion of a bank.

Q I'm talking about a skin flow, as he described it.

A Skin flow is not an immediate danger to the pipeline itself. It occurs right on the surface, and there would be no need to

do maintenance in a rush in situations where there are environmental sensitivities associated with that work, except to the extent that erosion would have to be stopped. Now in some of those cases it probably would be desirable to go in the summertime and do the maintenance then. Other occasions it is probably more convenient if equipment has to be moved in, ground equipment, it is better to do it in the wintertime. I guess that falls in the category of both.

Q Well now, the next perhaps obvious one is repair of ground surface depressions resulting from permafrost regression, and I take it first of all that that's a kind of work that the maintenance people will have to do on the ground.

A If it's very near the pipeline, perhaps there might be some work done maybe to fill the depression to prevent further permafrost regression. That work could be done as easily in the wintertime as the summer.

Q And what you're talking about here is repairing those regressions, if they are found on the right-of-way. You're obviously not going to repair any anywhere else, is that what you're saying?

A Well, and even then if they are close to the pipeline, regressions are a natural phenomena throughout lots of the north and we don't mean to reverse that natural process.

Q Yes, and you're simply concerned to repair the ones that are adjacent to or

threaten the pipeline security in some fashion.

A Yes.

Q And it's your judgment that that task can be performed in the winter.

A Yes.

Q How about repair of erosion control structures? First of all that's obviously something you're going to have to do, isn't it?

A Yes, if it's perhaps work on a river bank, training structure on a river bank, that one would need to be done on fairly short order. If erosion was occurring on a toe load, for example, on a slope, then the tow load would need to be replaced fairly quickly so as to prevent a slide occurring on the slope. So that one example would have to be done in the summertime.

Q Yes, or when it occurred. Well, it would occur only in the summer, wouldn't it?

A Yes.

Q How about rebuilding of the backfill berm over the pipe, or filling in depressions over the backfill berm?

A Probably both, Mr. Scott, depending on the situation. If it was a gradual erosion of a berm which was armoured on one side to carry run-off water down the right-of-way to a berm break where it could then be dissipated on the down slope side then that repair might need to be done fairly quickly in the summertime so that erosion damage wouldn't occur.

I don't know or can't think offhand any other reason to repair a berm. A berm isn't necessarily a desirable thing to have.

Q How about replacing of armouring in ditches and on the sides of the backfill mound?

A That's the one I think I just covered, and it would need to be done fairly quickly to prevent erosion damage.

Q That could be done, I presume, associated with the replacement of backfill or the berm mound.

A The original construction would be done when the backfill was replaced. The repair that was necessary would probably need to be done at the time that the damage occurred.

Q Yes. How about drainage of ponds or filling of pond areas along the right-of-way? First of all, that's a task that you may have to perform from time to time, as part of maintenance, isn't it?

A It seems an unlikely or at least infrequent problem to be confronted with. It sounds similar to the earlier one that you talked about which was to prevent thermal degradation in the forming of ponds, a thermokarst effect.

Q Well if ponds form when are they likely to be drained or filled in? What season of the year?

A They are not -- it's not

a phenomenon that progresses quickly, so it could be delayed until the most convenient time, which could be the wintertime.

Q How about control of icings along the right-of-way?

A It's not a harmful thing to my knowledge to either the pipeline or environmental considerations. I'm not aware that control or any corrective measure would be necessary, it's a common phenomena.

Q Well, Dr. Harlan's book, part of the application lists measures that will be applied in that connection. No doubt before the pipeline is built you'll have to read it and see what he tells you to do, but have you any idea at the moment as to when those icing control techniques will be done?

A I guess we're limited first of all to the winter or early spring, because that's the only time when the ice will exist. Offhand, Mr. Scott, I don't know what control measures there are. Maybe I'll need to check what control measures are needed.

Q Well, these geotechnicians, you know, left you a lot of things that they say that you're going to do on a regular basis from now over the next 25 years, and I'm just concerned to know what season of the year you think these things can be done.

A We can nail that one down to the winter and early spring.

Q How about the building or repairing of silt traps?

A If such traps were necessary, then again we're constrained by the seasons themselves and silting occurs only in the spring and summer.

Q And those will be the seasons? I have to tell you that Dr. Harlan again has said that you're going to be doing a bit of that. What about -- perhaps this is obvious -- the re-seeding of vegetated areas, will that be done in the spring and the early autumn?

A Yes.

Q And also we've been told that in unsuitable areas there will be planting of vegetation as opposed to re-seeding. I take it that that's a spring phenomena.

A Yes.

Q How about buoyancy control measures, when will that be done?

A We think it's extremely unlikely that any will be necessary; but if they were, it would depend on the seriousness of the problem. Probably in the wintertime when equipment could be moved into -- assuming that the control measure is to trench under the pipe or excavate under the pipe and lower it again and add more weights to it, that operation would be done in the winter.

Q Now the geotechnicians have also told us that as a frost bulb begins to develop and builds up, there will be another series of maintenance tasks that they've assigned to you,

relating to the control of icings, the construction of surcharge berms to reduce heave, the construction of new drainage structures designed to meet the heave as it arises, the filling of ponds, and the re-grading of berm breaks where heave occurs. What season of the year is this maintenance work going to be done?

A Much of that list,as I remember, some of them would be winter operations and others would be summer. The construction of the berm itself or of the surcharge --

Q Yes.

A -- requires moving of substantial amounts of aggregate material, and that could just be done in the winter when the surface is hard. The repair of drainage systems probably, depending on the repair work that's necessary, could be done either in the summer or the winter. I'm sure there are others I've missed.

Q How about the control of icings and new springs that develop?

A Control of icings have to be at the time that they occur, or while they're still there, so that's winter or early spring.

Q Well now, would you agree with me that all these tasks as they have to be performed may involve a trade-off as to timing between the necessity of doing the work reasonably quickly and the presence or anticipated occurrence of an environmental event of some type?

A In a general sense, Mr.

Scott, I'm sure that's true.

Q And do I understand therefore that both the maintenance manual and the staff you have at Calgary and at the District Headquarters will be -- the environmental staff that you have -- will be consulted to determine the timing of these various tasks?

A Yes.

Q And that system will operate in the same fashion as the aircraft system that we discussed earlier --

A Yes.

Q -- with the same personnel?

A Yes, there would be a continuing dialogue with all of those people involved.

Q Do you contemplate at least in the first year or two of operation, a fairly substantial number of maintenance tasks that will slide off in other years as you develop experience?

A There would be need for more frequent repair operations on the pipeline in its early years, and a much less frequent need for repairs in the later years.

Q Have you given any consideration to the development in the first year or two of a maintenance snow road along the route or parts of the route?

A No, we haven't.

Q Well now, if it was found necessary to do what the geotechnicians tell me has to

be done, that is to build along a substantial section of the pipe a berm or overburden to reduce the heave, and if that had to be done in the winter can you tell us how you're going to do it? Are you going to build a road for that kind of exercise to get the gravel and surcharge into the location?

A I can imagine that there may be a sort of winter road similar to the one that's been in operation from Norman Wells north to Inuvik for some years or some winters, which would be used by low ground pressure vehicles which would transport material from a borrow site or a stockpile site to the location on the pipeline.

Q What concerns me is, as I understand the evidence of the previous panel, that the risk of heave, if it occurs, is going to be very pronounced in the -- let's say the first five to seven years, in that period there, and in the discontinuous zone. Is there any virtue in a maintenance road, snow road for that period of time in the event that you have to bring large volumes of gravel and other overburden in?

A There may be, Mr. Scott.

Q Has any consideration been given to that as a contingency?

A No, we've not spent a lot of time on it. The area where frost heave is a risk tends to be down towards the southern part of the -- that portion of the pipeline north of 60, in that area. It's close to the river in some areas. We

are assuming or were assuming when this was written that the Mackenzie Highway would be constructed. There will be roads from wharfsites on the river into the right-of-way so there are many options on how you move material into the pipeline right-of-way.

Q Well now the geotechnicians told us that there would be very little buoyancy because they were going to protect you against all that; but they said if there was, that Mr. Hurd would fix it up. I just want to understand if that problem arises before startup, are you going to re-set the pipe or are you simply going to cover it and create a berm and build drainage structures?

A The usual practice would be to, as you put it, to reset the pipe, put it back underground where it was intended to be.

Q And I take it that that is the approach that is going to be used if there are any buoyancy problems before the startup? We may anticipate the pipe may be re-set, rather than simply covered.

A It's hard to say that there could never be an occasion where, or a situation where it might be more desirable to leave the pipe where it is. For example, if the buoyancy problem was only a slight upward movement that concerned us, but the pipe didn't float that may be a case where you would simply move in and add more weights and hold it at that level, without trying to excavate under the pipe, which is a very difficult operation.

Q And is environmental advice in the same fashion, particularly with respect to the movement of surface and ground water and so on going to be taken when that kind of problem is confronted?

A Yes sir.

Q And is it going to be taken through the same channels as we previously discussed?

A Yes.

Q Well now, let me turn to the general question of monitoring. The geotechnical panel also told us that as the pipeline is built, a number of monitoring devices will be built along its route in order to give the applicant knowledge of ground and other events, as they occurred along the route, and I take it that you're familiar with those.

A I believe so.

Q Yes, and Mr. Fielder already has referred to this, they also told us that a history of the trench, if I can call it that, a data bank of the trench on a mile by mile basis would be developed. You're familiar with that?

A Yes.

Q Where is this data bank going to be maintained?

A Probably at each District Headquarters.

Q And is there going to be someone there who is going to be familiar with how to use it?

A Yes.

Q Well, now let's deal with some of the other monitoring devices. Is there going to be monitoring of the pipe movement?

A If there are areas where we are concerned that movement may occur, but it is a very marginal situation and doesn't -- is not so serious as to cause the designers to add weights to insure that it won't occur then the best solution might be to bury it in the conventional way and install devices that would let the operating people monitor it so that there may be occasions, yes.

Q Well, I take it that -- I don't want to take you to it, but in the answer to question 55 on monitoring, the applicant indicated that the -- 55-2, pipe movement:

"Movement of the pipeline in previously identified critical areas will be monitored regularly to provide early detection of any detrimental conditions of frost heave, bouyancy and settlement that could lead to stressing of the pipe. The movement will be measured using marker rods rigidly attached to the top of the pipe and contained in an outfilled sleeve to separate it from the effects of adjacent soil.

"Automatic readouts and remote monitoring will also be considered for pipeline movement monitoring."

Now, do I understand that your department will be in charge of maintaining and reading this monitoring system?

A Yes.

Q Will you be in charge of installing it?

A It would be installed during the construction of the pipeline.

Q Yes, I see. Have you any idea, for example, how frequently monitors with respect to movement will be required to be installed?

A It would be a fairly infrequent operation, Mr. Scott, because pipe movement, certainly movement caused by frost heave is a very slow process. If there was movement caused by settlement, which is questionable, but again that would be a slow process, so infrequent reading would be adequate.

Q I didn't intend to direct you to the frequency of reading. I wondered if you could help us as to the frequency of the location of these devices.

A Oh, I see, the rods attached --

Q Yes.

A -- to the top.

Q The geotechnical panel

placed, as I think, some emphasis on the existence of this technique for providing you with information as to what was going to happen. I wonder if you can tell us how often these devices are going to be in place?

A If you will permit me some rough estimates, Mr. Scott --

Q Yes.

A I would suggest that if the monitoring is to watch for perhaps floatation caused by bouyancy of the pipe, then one every 100 feet or 200 feet or 300 feet probably is adequate because if that occurs it is very long sections that would rise up.

Q Well, now, --- I am sorry.

A For monitoring of frost heave then some shorter intervals would be desirable.

Q I take it that you will also be responsible for maintaining and reading the ground thermal regime monitors that the geotechnical panel referred to?

A Yes.

Q How often are they going to be placed?

A They are required , for example, on a slope which might become unstable if the permafrost was allowed to thaw and each slope of course is different in its dimensions, but locations could be selected where a change in the theremal regime could

be detected if that was occurring. I'd guess that not very many locations would be necessary. They need to be carefully selected is all.

Q Well, I think Dr. Morgenstern suggested to us that a mile by mile analysis would have to be made, but these -- these monitors in conjunction with slope stability monitors would exist in anywhere up to a hundred cases.

A On a hundred different slopes.

Q Yes, and I take it there might be more than one monitor on the slopes?

A Oh, yes.

Q Yes.

What I am getting at is this going to be a heavy task for the maintenance force and involve periodic but regular visits to the site ?

A I wouldn't characterize it as a heavy task, Mr. Scott. They would need to check them frequently in the early -- during the first season frequently. Less frequently as time goes on -- probably after a few years have passed they will no longer be concerned.

Q Well, let's say in the first season, how often do you think these monitors are going to have to be read? A ballpark figure.

A We would get advice from the geotechnical people on that one. My guess would be every month or so during the summer.

Q And I take it that this

requires the entry of somebody in there physically or the landing of a helicopter or what have you.--

A Yes.

Q -- to -- and I take it that those flights were not included in your routine patrols of the line?

A That is correct.

Q Would any of this -- what is the season over which you would want to read these meters?

A Oh, it would be done in the summertime, otherwise the information wouldn't be relevant.

Q Well, I am new here, when does the summertime begin and when does it end?

A At what location, sir?

Q Let's take half way up. How many months of this is going to go on?

WITNESS FIELDER:

A If I could interject a comment here, I suggest that if it is in the Norman Wells area you would probably pick some time in early September as one of the times for reading because that is the date at which the active layer normally reaches its deepest depth and hence is the time of most concern. YOu would probably pick sometime in mid-July and sometime in early spring. Perhaps three times a season, during the thawed period would be

satisfactory and those dates would be shifted either forward or back depending upon whether you went north or south.

Q Over two or three months?

A I would say from June to September, perhaps three readings.

Q Yes. Well now, I take it, Mr. Hurd, it is going to be the responsibility of you people to collect the information or the readings, then what are you going to do with it?

WITNESS HURD: As long as the readings indicate that there is no undue permafrost regression , we do nothing to it.

Q Well, who is going to make that judgment? Is it going to be the maintenance people at the District Headquarters, or is that decision going to be made elsewhere?

A A lot of the judgment could be made by the operating people at the district or Division Headquarters. If it's a more complex problem, then advice would be sought from geotechnical experts.

Q And who is going to decide what remedies or solutions are appropriate in each of the cases?

A Most often the district manager who again would consult with people in the Division Headquarters and consultants, wherever he needed to go to get the information he needed.

Q What I'm really concerned about is the flow of information. As I read their evidence, both Dr. Slusarchuk and Dr. Morgenstern, dealing with frost and slopes, placed a great deal of emphasis in their assurance that this could be done on the existence of these measuring devices and the data bank about the trench would keep the constantly in touch with developments as they occurred on the ground so that they could anticipate problems. Now, what I'm concerned about is in the field day by day how is that process going to operate? Who is -- are

you going to have a slope stability man on staff?

A I doubt we need that, Mr. Scott, although the engineering group in the Division Headquarters would have some expertise in that area. But they would be aware of which slopes the design people said might be sensitive or subject to slides. Part of the routine operations would be the gathering of this information and its analysis, and the following corrective measures, if that was necessary.

Q Well, let me ask the question more concisely, if I can. The expert panels that have been presented to the Inquiry have comprised employees of Northern Engineering Services and outside part-time consultants. None of them, as I understand it, perhaps with one exception, is an employee or anticipates being an employee of the applicant, Arctic Gas. Now what resource are you going to have to assure us that expertise will be available to analyze this data and respond to it on a day by day basis when the pipeline is built and in operation?

A The question was what resource will we have available?

Q What personnel are you going to have in place of Dr. Slusarchuk and Dr. Morgenstern and Dr. Hardy and all the other experts that are now available to say how things will be run?

A The engineering people on staff will be knowledgeable in these areas, and to the extent that they need help, I think we can assume that consulting assistance will be at least as available

then as it is now. It's not uncommon for pipeline companies, when an erosion problem develops, or when a pipeline instability problem for any reason develops, to go to consultants such as Dr. Hardy or Dr. Morgenstern and obtain their advice on what should be done in a certain situation. A large part of the work they do is just that.

Q Well, Dr. Clark's panel told us that at least during the construction phase there would be geotechnical monitors on the ground observing and commenting and directing the work who would have the same -- not the eminance perhaps -- but the same geotechnical background and experience that was represented on that particular panel. Are you going to have any such resource in terms of your operations and maintenance program?

A Not in the same way, Mr. Scott. The consulting people will be available to the operating staff. I can't imagine needing a very specialized sort of advice with any frequency at all. It would be the rare occasion where a particular problem has come up and the people on staff will be expert enough in that area to recognize that it is a particular problem, and expert consulting people will be available to them.

MR.SCOTT: Yes. Dr. Fyles has handed me a note commenting that yesterday you told us about multi-discipline employees. Perhaps you could teach Dr. Slusarchuk to drive a truck. It's 12:30, Mr. Commissioner.

THE COMMISSIONER: Yes, I think it is 12:30, so we'll adjourn until two o'clock this afternoon.

(PROCEEDINGS ADJOURNED TO 2 P.M.)

(PROCEEDINGS RESUMED PURSUANT TO ADJOURNMENT)

MR. SCOTT:

Q Mr. Hurd, I gather from Section 14 of the application that the applicant visualizes that after abandonment which I guess is not one of our immediate problems, but that after abandonment the pipeline will be simply left in place.

WITNESS HURD:

A We consider that a possibility, Mr. Scott. It is not uncommon for pipelines that are abandoned in these days to leave the pipe in the ground.

Q Yes, in view of the considerations that you have discussed with us relating to erosion and slope stability and so on. Has any consideration been given to some form of patrol or right-of-way maintenance at that period and thereafter?

A We've not considered it in any detail, Mr. Scott, we imagine that abandonment occurs probably forty or fifty years in the future.

Q Oh, I thought it was 25 to 30 years.

A No, the pipeline can be expected to operate on the basis of reasonable estimates of potential reserves for much longer than the 25 to -- 20 to 25 years.

Q I see. In any event I gather, no premature consideration has been given to those matters?

A Not in detail. We imagine

that the same procedures could be applied after abandonment if the pipe is recovered which would make those procedures necessary that are applied after construction.

Q Now, in response to the Assessment Group's concern, response number 56 and I don't think you have to trouble to get it out, it was indicated with respect to abandonment that one consideration difficult to predict was whether permafrost would thaw out in the long term and the answer provides that "an indication of areas along the right-of-way where this permafrost thaw may occur may be obtained by observing the changes in the permafrost table at the edges of the right-of-way." And I take it that you are familiar with that general approach to the problem?

A Yes.

Q When do you intend to begin to do this monitoring of the table along the edges of the right-of-way?

A It could start quite early, Mr. Scott, after construction. That sort of natural regression of permafrost would be a very slow process --

Q Yes --

A -- and probably looking at it or checking once a year would be more than adequate.

Q Do you intend to start that kind of monitoring as part of the operation

and maintenance phase at the beginning?

A In areas where regression of the permafrost would put the -- might put the pipeline in jeopardy then that would be checked starting early, yes, sir.

Q How is that kind of monitoring going to be done?

A Probably by very simply probing through the active layer at that time of year when it is at its maximum depth.

Q Yes, have you made any preliminary determination as to the portions of the right-of-way or the extent to which the right-of-way will be monitored in that fashion?

A Not in detail, Mr. Scott. We would need to know the type of soil in which the pipeline's been laid to know whether it s high ice content material or whether it is harmless if the permafrost does regress.

Q Will that be a determination that you can make after your completed soil survey's in hand?

A That would be done during construction.

Q Yes, have you given any thought to beginning this monitoring process in a general way before clearing of the right-of-way so that you will have a control against which to measure the subsequent monitoring?

A Not in that specific way.

The comparison can be made by probing just outside the right-of-way where it was not cleared, so it is easily compared.

Q Well, now, some other unrelated questions connected with security of the line and the public. You have conceded, I think that it is inevitable that the line, the right-of-way will cut through not only hunting and trapping areas, but across normal travel routes that people living in the area will have become accustomed to use.

A I think that is probable, yes.

Q And I take it that it is evident that the existence of the pipeline and the compressor stations will at least for awhile be an object of curiosity and people travelling or trapping in the neighbourhood will come out and have a look to see what is going on at your compressor stations and on your line.

A Probably.

Q Yes, and I take it that in those circumstances, neither the compressor stations nor the stockpile sites and equipment storage points will be manned or protected apart from a fence?

A Plus perhaps in critical situations an alarm system that would alert the Gas Control Centre that there's been a break-in -- if I could call it that.

Q Well, if someone gets over your fence at a compression station, where is the alarm bell going to ring?

A In the Gas Control Centre.

Q That's not in Calgary, is it?

A Well, yes sir, it's there and the information would be available also at each District Headquarters.

Q Is there any other plan under way or being considered to ensure the security of the facilities, and I speak not only of storage depots but of compressor sites, apart from the fence and an alarm bell?

A There would be the usual precuation of locking doors, locking the gates on the fence, that sort of thing. Beyond that, I'm not aware of any discussions we've had.

Q Well, isn't it possible that these sites will be, if care is not taken, of some danger to an impertinent and unlawful intruder.

A It could be.

Q Well, what steps are going to be taken to protect against that eventuality?

A Only those, Mr. Scott, that I talked about up till now. They are the only

ones that we have discussed up to this stage. Certainly there would be warning signs, and I'm talking about the protection of the people who would go in, there would be warning signs so they would understand that it's a hazardous area.

Q Well, I really raise the question because the sense that the compressor stations will be unmanned causes me some trouble. In fact, is there any plan on foot to devise a scheme and a complement structure whereby they can be manned?

A The personnel complement that the company has for each of the five operating years includes enough technicians so that at least two could be located at each station for as long as it takes until we're satisfied that they are no longer reqired. So in that sense we are capable of manning them.

Q Well let me ask you then, I know you'll be as candid as you have been all along. Is it, after the first year of operation is it -- is there not a very reasonable prospect that these compressor stations will have to be manned?

A After the first year?

Q After the first year, which is obviously a difficult year, but after that isn't there a reasonable prospect that you will have to devise a manning complement for them and in fact man them on a full-time or at least substantial basis?

A In my opinion, Mr. Scott, no. It's not uncommon for pipelines to operate under

the mode that we've described, the remote automatic control.

Q Well, leaving aside the security of the line from the point of view of its owners, are you satisfied that all possible or desirable precautions have been taken to protect the public lawfully or unlawfully entering the facilities?

A We have considered all that have occurred to us, Mr. Scott. I can't think of any other precautions that we might take.

Q I take it that the public, and particularly the hunting and trapping public, are going to be permitted to use the right-of-way and cleared areas for travelling and for hunting and trapping purposes.

A Yes.

Q Now, this morning we discussed routine maintenance and patrols, and I'd like to ask you some questions this afternoon about major repairs and unexpected contingencies but before doing so I would like to deal with the equipment that you've described, or that Mr. Fielder has described as being utilized. In particular, the rologon which was shown, I think, in one of the photographs, and the A.C.V. Now I take it both you and all members of the panel understand that these pieces of equipment, like others, have their optimum uses, and they are specified generally by the manufacturer or supplier, is that correct?

A Yes.

Q And for example, dealing with the A.C.V., I think everybody understands that stationed at Inuvik it may indeed be a very useful piece of equipment in carrying large supplies in volumes along the North Shore and up to Arctic Red and on such trips as that, and that would be the kind of usage of that equipment that is clearly contemplated by the manufacturer's specifications; isn't that so?

A Yes, that's correct.

Q I must say, and perhaps Mr. Fielder corrected it this morning, our concern about this and other pieces of equipment arose when we began to get the impression that if the A.C.V., for example, was going to be used to travel along the right-of-way up 8-degree hills and over six-foot objects, let me just ask a couple of questions: I take it that there is going to be no experimenting with the use of any of these vehicles?

A I wonder if I might refer that question to our vehicle expert?

Q I think he was trying to tell us this morning that there wouldn't be, and I just want to have it confirmed.

WITNESS FIELDER: You thought I said this morning that there would be no experimenting with A.C.V.s?

Q The way it was left yesterday was that it seemed to me that the prospect of the utilization of the A.C.V. was to cover a whole range of uses, some of which would be perhaps a little

unusual for it, and I understood you to say this morning that in fact that would not be the case. Am I correct, that it would be used as its specifications -- as its manufacturer's specifications detailed?

A Should we purchase an air cushion vehicle that has been designed and in operation with a certain set of specifications, we would certainly use that vehicle within those specifications. However, I tried to point out this morning that because we suggest that we would own an air cushion vehicle doesn't mean that that vehicle would be utilized in all cases for all contingency purposes, that we would have different types of L.G.P. vehicles available and that further than that, some of the air cushion technology can be applied to the L.G.P.s as well as to normal highway type trucks, that is air cushion assists can be put on trucks, they can be put on L.G.P. type vehicles, so that a whole range of applications is available to us, and that we don't want to make a selection or even try to decide what should best be used in a particular circumstance until close to the time when we're going to have to use it, so that we can take advantage of all of the technological advances being brought forward by the manufacturers, as well as the government-sponsored group that I described to you this morning.

Q I understand all that, and perhaps I haven't made myself entirely clear. The -- all these vehicles are capable of damaging the terrain or the environment if improperly used. That's

obvious, isn't it?

A Yes.

Q And the manufacturer specifies the circumstances and the utilization that can appropriately be made of them.

A Yes sir.

Q Now I take it it would not be prudent in terms of the company's own resources to make uses of these vehicles that are beyond their specification.

A Quite correct.

Q And I presume further that there will be in the operations manual that we have talked about in due course, a stipulation as to the way in which these vehicles will be used by the company.

A Yes sir.

Q And your only reservation this morning was to keep open the possibility that the vehicles' permissible uses might expand as each manufacturing processes develop .

A Yes sir.

Q But I take it that there is going to be no experimenting as such to see how far you can push these vehicles on the terrain or over the water.

A Oh yes sir, there very likely would be experimenting carried out, both by the manufacturer and by us, prior to purchasing one. Should we decide that we want to purchase a particular

type of vehicle, I'm certain that we would want it tested under winter type conditions.

Q Yes, but you're not going to -- I'm trying to be helpful because I think I understand what he's saying -- it's not your attempt to test out these vehicles on the terrain as you use them, because great damage can be done to the terrain if those tests fail.

A Excuse my density, I am missing your point. If we have a piece of equipment and we use them, the fact that we have used it on the terrain implies that it's been tested on the terrain.

Q Well, let me put the concern, and it's a real one, to you here. There are -- these are large pieces of equipment which can cause serious damage to terrain, if improperly used.

A Yes.

Q I put it to you that you are going to find out when you purchase them the permissible ambit of their use, the ways they can be used.

A No sir, I'm suggesting we'd find that out prior to purchasing.

Q All right, prior to purchasing, and that you won't use them in any other ways.

A That's quite correct.

Q All right, and there will be no -- and the ways they are to be used will be spelled out in the current operational manual.

A That's right.

Q Yes, and there will be no high wire artists running around trying to develop and experiment new ways of using them over this sensitive terrain.

A With the exception of your description of our testing personnel. If we got a piece of equipment that was proven for a particular job, I see no reason why we couldn't test it for some other job to see whether or not its uses could be expanded. I think that's something that we would want to be able to do.

Q Well, perhaps you and I can't get together on this, Mr. Fielder, but what I was concerned to point out, and I took it to be the position of the applicant, that if this A.C.V. has never gone up, as far as you know, a 10-degree slope, you're not going to try and make it go up a 10-degree slope and risk the environmental damage that may occur if it either succeeds or fails.

A O.K., if the air cushioned vehicle is specified to go up an 8-degree slope and I attempted to pull it up a 10-degree slope, all that would happen is that it may or may not get up the slope. It wouldn't cause any particular environmental damage that I am aware of.

Q Well, that remains to be seen.

A No, sir, I don't think it does. I think it already has been demonstrated.

Q Other equipment can cause terrain damage?

A Air cushion -- excuse me, air cushion vehicles that I am referring to.

Q All right.

A Some of the other towing type of equipment can negotiate 50° slopes, very extreme slopes and providing that they can pull an air cushion vehicle up the slope without causing damage themselves, the air cushion vehicle is not likely to cause any damage.

Q Well, if it gets stuck it is going to have to get out of there.

A The air cushion vehicle.

Q Yes, if it doesn't make it.

A Yes, sir -- it would pick itself up on its air cushion and slide slowly back down the hill.

Q I see.

A Let me emphasize though, Mr. Scott, that any testing that is done to stretch these machines to something beyond what is specified would be done under a controlled condition. It wouldn't be done just by somebody jumping on the thing and tackling a hill.

MR. GENEST: A high wire artist -- just thought that I would let you know that I was here.

MR. SCOTT: That was obvious, Mr. Genest.

Q Well, I guess we will have to leave it this way, that we will have to await the operations and maintenance manual to see then how this equipment is going to be used.

WITNESS HURD:

A Mr. Scott, we might add one more comment on the thing. The operating company contemplates the purchase of some unusual pieces of equipment and the purpose of that equipment is to allow operations to go on without damage to the terrain. Maybe the reason that we are having some difficulty understanding the point of your question is that it seems so illogical to then use that very equipment to go out and damage the terrain. Our object first of all is to avoid the damage of the terrain.

Q Well, I understand that is why the purchase is motivated, but everybody is familiar with the circumstances in which vehicles are pressed beyond their normal use and terrain damage can occur. I was simply trying to get a statement from the applicant that as a matter of policy that was not going to occur on this pipeline. But if it has to be left there it has to be left there.

Mr. Hurd, there has been in your cross-examination by the others a number of discussions of what will occur in the event of a failure and the word failure has always been used in a context

which leads me to think of a break or a substantial leak in the pipe in respect of which it has to be shut down or immediate repairs instituted. Is it correct that the term "failure" can also cover a series of developments or occurances at the pipe which are less serious and in which the remedy may be postponed.

A Yes.

Q For example, if you encountered a small corrosion leak on the pipe, I take it it would not necessarily follow that all your heavy equipment had to be rushed in in the month of May to repair it, that it might be possible to postpone the repair, even though that be a pipe failure until some more appropriate time of year?

A Yes, that is true.

Q Yes, so that failures first of all, failures in the integrity of the pipe can be divided into two types. First, those which would require the shutting down of the pipe immediately, and secondly, all others in which remedy can be postponed --

A Yes.

Q And I take it that experience would indicate that the vast majority of so-called faliures are in the second category where remedies can be postponed for varying periods?

A I think that is true, Mr. Scott, if all of those examples include situations where gas is escaping from the pipe itself, then both categories occur so infrequently that I don't know

how to judge the relationship between those two very infrequent things.

Q Well, how about buckles in the pipe, for example?

A I am sure it is possible and probably has happened. I have not been associated with any situation where a buckle occurred after the pipe was installed.

Q Well, now, if that is a conceivable division then of events into true emergencies and emergencies the repair of which can be postponed for varying periods of time, let us look at the true emergencies and I take it that when you have a true emergency which we may define as one which would lead to the shutdown of the pipe, there there are again two responses to it. One is to do a detailed and thorough repair and the second is to develop and apply some short term solution which will permit the continuance of gas until the full scale repair can be made in a better season.

A Yes, that is correct.

Q And I take it that it would be the policy of the applicant to utilize the second technique when environmental considerations dictated it? Where possible?

A Yes, where that is feasible to do, yes, sir.

Q And again I take it that confronted with every emergency except the emergency

which gives no time for thought, but confronted with every other of the categories we have discussed, is it the policy of the applicant to consult with the environmental staff that you described this morning?

A Yes.

Q And again I take it that the ultimate decision after that consultation takes place is in the hands of the district supervisor or persons above him?

A Yes, that is right.

Q And I take it that in considering the extent to which a repair situation may be postponed to a better time, you will have regard not only for environmental considerations, but also to any social or economic considerations affecting the people in the neighbourhood of which you are aware?

A Yes.

Q And I also understand, and tell me if I am wrong, they will be given equivalent weight. We are not only concerned about birds, we are also concerned about people who happen to live in the communities.

A Yes, indeed.

Q Well, now, let me take an example so -- to see if I can gauge how the applicant in a hypothetical case will respond to this kind of situation. -- You may be familiar by looking at the chart, if not otherwise, that the pipeline route crosses the Donnelly River which is

between Norman Wells and Fort Good Hope and it crosses it, Ithink, about a mile and a half below the outlet of/the Chick Lake. Are you familiar with that location?

A Yes.

Q And I understand that that river is an important spawning and nursing area for grayling?

A I don't know of that of my own knowledge, but I accept it.

Q Well, let's take that as a given and I refer you particularly to P.J. McCarts, Volume XX in the Applicant's biological series in which he makes that statement. He also states, and I ask you to take this as a given, that the grayling use an area about 1 mile on either side of the proposed pipe for a period of six weeks, for spawning and hatching from May to early July and then they continue to use it as a sort of a nursury area until November.

Well, now, let us into this situation pose a pipe failure such as a corrosion leak of such an extent that the gas pressure would not be maintained.

That is a serious leak, is it not?

A Yes it is.

Q One in which shutdown of some kind would be unavoidable if not repaired?

A Yes.

Q And let us assume that the leak occurs in the river bed during the first week of July, in the crucial grayling period. Now first of all, that event would be a true emergency, would it not? As opposed to an event, the solution of which could be postponed eight or ten weeks.

A It would need -- if the pressure in the pipeline was being lost, that's a serious situation.

Q A true emergency?

A Yes.

Q Now, is it an emergency to which you must respond by digging up the pipe, or are there other alternatives that can be applied in that situation, to ameliorate the environmental hazard? If they are, what are they?

A Yes, in that situation, Mr. Scott, one other alternative would be similar to the repair procedure we described in -- to question 54, I believe it was, the repair at river crossings, which would be to expose the pipe on either side of the river bank, install a smaller diameter heavy wall pipe across it. I think I remember the Donnelly River at that location, its banks are reasonably high and they are not wide apart, and a smaller diameter

pipe, for example 42-inch, would easily span that area so a smaller diameter line could be installed as a self-supporting span between the banks and tied into the mainline at either side, and the pipeline could go into operation in a very short time. The installation --

Q Would it be suspended above the water? I'm sorry, I'm just trying to clarify.

MR. GENEST: Well, he hasn't finished.

A Then the installation of the permanent full diameter crossing could be done at some time of the year when there was no hazard to the fish in the river.

MR. SCOTT: Would that be a suspension above the water?

A Yes.

Q Now, I don't make any criticism of this because I didn't know until Dr. Fyles told me, but you and I didn't know that this location was the key spawning area for the grayling. In this situation, how are you going to find that out?

A Well, the description of the use that's made of the river by fish would be included in the operating manual, and the seasons when disturbance to those fish might be serious would be also in the operating manual, so we know from that source, but a repair operation that large wouldn't

First of all, the necessity of moving heavy equipment and supplies, such as backfill or gravel, over poten -tially fairly substantial distances at unfortunate times of the year. Would you agree with that as a substantial cause of damage, if not --

A As a risk, potential risk.

Q -- a potential risk?

A Yes sir.

Q And the second potential risk we envisaged was the necessity for crossing or fording a substantial number of valleys and rivers, where the situation may be difficult because of the season, again as an area of potential risk.

A Yes, there are risks associated with crossing valleys and rivers, yes sir.

Q Well now, in reviewing your plan for dealing with these contingencies, we had two subjects of concern, I'll give them to you one following the other, and then ask you some questions about them. The first concern was the plans and procedures for getting across valleys and rivers, and in the second place, the quantity and deployment of repair equipment and vehicles. Now dealing with valleys and rivers first of all, I take it you are familiar with the Assessment Group Report which has focused on the special sensitivities of valleys in terms of construction and in terms of their location and so forth.

A Yes.

Q And you would agree that the same concerns -- at least in part -- will apply in terms of operation and maintenance.

A Yes.

Q Well now, in the Assessment Group Report they prepared a sensitivity table relating to valleys and river crossings. Are you familiar generally with that?

A I'm aware there was a table. I can't claim to be familiar with it.

Q And that in that report a number of valleys and rivers on the route were flagged as having a higher potential for damage than others and I take it that even if you hadn't seen that you would be in a position, or your people would be in a position to do precisely the same kind of thing in terms of operation and maintenance.

A Yes.

Q Well, is there any virtue in attempting, in your repair operation, to develop special procedures that are related, let us say, to 10 or 15 valleys?

A Oh, I see. Mr. Scott, we described earlier that the operations and maintenance manual would include contingency plans which would be applied to specific sections of the pipeline in the event that a break or some repair procedure was necessary within that section. Each of those plans probably would be different from the others, and each would include descriptions or instructions on which

equipment would be -- could be taken from which location, how it would travel to that location, and it would take into account sensitivities that might exist in one season but not in another, and so it would deal with it season by season. So those, I think we're saying the same thing except that I'm suggesting that rather than isolating valleys by themselves, and describing procedures for crossing them, I'm saying that for a contingency repair plan that the crossing of sensitive valleys would be included within that plan.

Q Yes, but as you reviewed the matter you'd have no trouble in listing a series of valleys and rivers which, if you had to cross, are either going to be difficult to cross or run a high risk of potential environmental damage.

A Certainly we could list the valleys, yes.

Q Now, would you propose to try and develop special solutions on a seasonal basis, if you want, for each of those valleys?

A Yes indeed.

Q What sort of special solutions would you have in mind?

A To deal with the season in which the terrain is most sensitive we would determine whether or not the vehicles, the low ground pressure vehicles that are available to the operating company can cross the valley following the right-of-way. If they could not, a route that differed from the right-of-way would be selected and this would be done well ahead of when the need arose.

Q Are you thinking there of an access road of some type?

A Yes.

Q Would that be a permanent access road? -- For that valley?

A Whether it would be gravel covered or not is a different question. It would be there permanently. Its object is to provide a routing for, for example, an air cushion vehicle that allows it to go down slopes that are gentle enough that can be handled and to cross the river at some other location and come back to the right-of-way and proceed along it from there.

Q What other kinds of solutions might you want to consider at those high risk valleys and rivers?

A We'd examine pretty carefully the use that might be made of helicopters, large helicopters that have a good heavy sling load capability, so that we would stay off the ground entirely, that is probably the first thing we'd look

at.

Q Might you give any consideration to stockpiling bridge units, for example, at particularly difficult rivers?

A We hadn't considered to my knowledge stockpiling -- did you call them bridge units?

Q Yes.

A That equipment is transportable and could be moved from locations which would be selected so that they are near these sensitive valleys. Crossing the river itself is a question a little different than getting down the slopes on either side.

Q Well, then coming onto that would you consider for example, stockpiling supplies and equipment on both sides of particularly difficult rivers and valleys so there would be no necessity to cross them with heavy equipment and supplies?

A To a large extent that is included, yes--

Q Yes.

A -- in the plan. For example, replacement pipe which would be stored along the right-of-way at intervals -- those storage sites would be selected keeping in mind that if a break occurred at a certain location then we want to avoid having to cross a river with that very heavy load.

Q Well, then do I have it this way that as you proceed to your contingency

manual, you will agree with me that it will be one of its functions to try and isolate rivers or valleys that are potentially hazardous or that risk environmental damage at certain or all seasons?

A Yes, I think we are saying the same thing. A plan would be devised having in mind that certain valleys are sensitive and would be designed to avoid crossings of those wherever possible.

Q And you will have a range of potential solutions that will be designed for that particular valley or perhaps one or more that will obviate the necessity to cross it or provide for an easy crossing of it.

A Yes.

Q And I take it that all that work essentially remains to be done?

A The detailed plan for each section of the line, yes, sir, remains to be done.

Q Well, now, the second issue was deployment of equipment and I understand that the deployment that you have shown on the charts is as yet tentative, is that correct?

WITNESS FIELDER:
A Yes,sir.

Q But I also understand that it does reflect the -- your present view as to the overall number of pieces of equipment that you would expect to have?

A Yes, sir, in general that

is the case.

Q You agree with me that obviously more equipment, if more equipment is purchased, it may indeed reduce the necessity of travelling with it over longer distances.

A Properly deployed, that is quite correct.

Q Yes. Isn't that a desirable kind of insurance, even though it may never be used?

A Should we find the situation that you described to Mr. Hurd a few moments ago that most certainly would be the case.

Q So I take it that you have not ruled out the purchase of additional equipment if as a kind of environmental insurance it should be seen to be desirable?

A No, sir, the selection of the type of equipment and the number of pieces of each type of equipment and their location will have to be made not considering either of those parameters in isolation. They all have to be looked at together in conjunction with the sort of sensitivity problems that you just mentioned and we will learn a lot about that as the design of river crossings takes place because a lot of the information that you have just described as being necessary knowledge for O and M purposes, will also be necessary in order to have a river crossing properly designed and constructed.

Q Yes, but I take it that the issues that are at play when you come to consider how much equipment you will purchase for repair work, are first of all, cost on one side and on the other side, security of the pipe from the owner's point of view and secondly, environmental protection.

A Not necessarily in that order, but certainly they are all parameters.

Q And that there is therefore no determination that the number of units and the kind of equipment you selected is necessarily fixed.

A That is quite correct.

Should we find, for example that two sensitive river valleys isolates a portion of our pipeline that we could not get to from the stations on either side, then the sorts of considerations that you and Mr. Hurd have been discussing would come into play and perhaps the solution would be to store some other equipment between those two river valleys --

Q Well, that deals mainly --

A -- however it may not be that answer as well.

Q That situation deals with a case in which access cannot be obtained, would you agree with me that if you found that access could only be obtained at high environmental risk in the same way you would be prepared to go to the purchase of more equipment and store it somewhere conveniently so that you would not be exposed and we will not be

exposed to that risk.

A Absolutely. I was not separating the two.

Q Because one of the things that concerned me is that if you look at the spacing of equipment on parts of the route it seems to be extremely random and without any regard to any principle that I can divine.

For example, if you take the section between Travaillant Lake Junction and Fort Good Hope, there are four compressor stations, one is M-03 and that is a good one because it has got a 6,000 foot airstrip and fifteen vehicles. The next is M-04 which is a 6000 foot airstrip, three vehicles. M-05 has a 2,400 foot airstrip and four vehicles and M-06 has a helipad and nothing else and twelve vehicles.

Now, if I read that chart right I frankly do not understand the principle upon which the equipment has been deployed and stationed in that fashion. Is there any principle there that I should refer to?

A Generally it refers to access via the highway system.

Q What highway system?

A We are talking about the highway, the Dempster Highway south of Inuvik.

Q I see. Well, let me ask you this. Why would it be, for example, that at a station where you have merely a helipad you have

stationed twelve vehicles, that is, M-06 Whereas, one where you have a 6,000 foot airstrip you have only stationed three? M-04.

A Sir, without the maps I find it difficult to answer you specifically, but in general I gave last time would be the answer, that there are other means of accessing that part of the right-of-way than from the equipment that has to be stored at the sites.

Q Well, doesn't that assume that the Mackenzie Highway was built? We are talking about the area between Travaillant Lake and Fort Good Hope.

A No, sir, the assumption was that the Mackenzie Highway would be built to Fort Good Hope, as I recall, and that the Dempster Highway coming down south is completed, coming down south from Inuvik is completed.

Q Yes, but is your contingency plan based on the completion of those two highways?

A The contingency plan will be based on whatever is completed at the time that the contingency plan is put together, sir. We have not prepared one as yet.

Q Well, if your pipeline were built today and you had to be operational tomorrow I take it that the deployment of equipment between M-03 and M-06 that you have listed would have to be totally rearranged.

WITNESS HURD:

A Mr. Scott, that is fair enough if we assume that the pipeline is built today to assume that the highway is built today.

Q Gee, I hope that the applicant has a better chance than the highway people -- no, but you have shown us a list of deployed vehicles. Do I understand that that list would be totally inappropriate if the circumstances that exist today exist when your contingency plan is to go into effect?

WITNESS FIELDER:

A No,sir, it would not be totally appropriate --

Q Largely appropriate.

A It is based on a certain set of ground rules and if thoe ground rules change then certainly the selection and deployment of equipment will change to suit.

Q In any event, this deployment that you have presented to us is based on the completion of those two highways?

A To the points that I have mentioned, yes,

Q Yes.

What you are calling the Dempster Highway and confusing me is in fact now part of the Mackenzie Highway that goes from Hay River to -- or the designed Mackenzie Highway that goes from Hay River to Inuvik, isn't it?

A I did not think so, sir, it seems to me that that is the highway that has

already been at least partially constructed coming south out of Inuvik. Am I confused or are we both confused?

Q Well, I am certainly confused.

WITNESS HURD:

A I think, if I can add a little bit, the Dempster Highway being ahead of the other in time comes from the southwest past McPherson and crosses the river and goes on up to Inuvik and it continues to be called the Dempster Highway in that area. The Mackenzie Highway coming from the south will connect with it near the south end of the delta.

Q In that context, the Mackenzie Highway stops at that point, then it becomes, if you will, the Dempster Highway.

A I think that's been the common usage.

THE COMMISSIONER: It doesn't stop there, it's got to get there first.

MR. SCOTT: Dr. Fyles tells me they have officially changed the name, but I think our situation is clear.

Q But I take it that this deployment of forces is based on that kind of assumption and as you move toward the actual deployment there may be all kinds of changes.

A That's quite correct.

Q So that there is no point in us attempting to examine whether the placement of 15 trucks at M-05 is suitable or not, because it all depends on whether the highway is going to be built.

A Not only that, sir, but as we've said before, there may be completely different types of equipment may be available within that period of time, and hence change.

MR. SCOTT: I think those are all the questions I have. Thank you, Mr. Commissioner. Thank you, Mr. Hurd.

MR. GENEST: No re-examination, Mr. Commissioner.

THE COMMISSIONER: Well, that completes the evidence of this panel, and Mr. Hurd and

Mr. Fielder and Mr. Carlson, I want to thank you for coming and for being so patient with all of us in answering questions. You're excused.

(WITNESSES ASIDE)

THE COMMISSIONER: Mr. Genest, I'm in your hands. You have Mr. Horte giving evidence, I understand. Do you want to start now? You're welcome if you want to wait until nine in the morning, that's all right, too. I'll leave it up to you.

MR. GENEST: I think we'd like to start now, sir. I wonder if we could have a five-minute break to get the --

THE COMMISSIONER: Yes, certainly, let's do that.

(PROCEEDINGS ADJOURNED FOR FIVE MINUTES)

(PROCEEDINGS RESUMED PURSUANT TO ADJOURNMENT)

MR. GENEST: Mr. Commissioner, as you can see, our next witness is Mr. Horte, who is the president of Canadian Arctic Gas Pipeline. I thought I should say, sir, before reading the examination in chief that Mr. Horte is being called in relation to matters pertaining to Phase 1 of these hearings, and also to answer some of the specific concerns posed by you, sir, and be available for cross-examination to some of the parties who didn't get as far as they wanted with some of the consultants. I want to emphasize that Mr. Horte will be recalled at a later stage to deal with policy matters arising out of subsequent phases of these hearings, and I thought I should state this at the outset so that the impression

will not be created amongst the participants that this is the only chance they have to cross-examine Mr. Horte. I will be asking you, sir, I hope that the need for any ruling will not arise but I want to give notice that I will be asking that the cross-examination should be reasonably limited to matters properly pertaining to Phase 1 of the hearings.

With that I wonder if I might ask if Mr. Horte could be sworn?

VERNON L. HORTE, sworn:

DIRECT EXAMINATION BY MR. GENEST:

Q Mr. Horte, you are the president of Canadian Arctic Gas Pipeline Limited.

A Yes sir.

Q And also of Canadian Arctic Gas Study Limited.

A Yes.

Q These are sister companies, are they?

A Yes.

Q And I understand, sir, that you're also the vice-chairman of the Alaskan Arctic Gas Pipeline Company and the Alaskan Arctic Gas Study Company.

A Yes, I am.

Q And you were born in Kingman, Alberta in 1925.

A Yes, I was born then.

Q How far is that from

Mr. Gibbs' place?

A I'm not sure, about 200 miles, I think.

Q And I understand that you served in the Second World War with the Royal Canadian Air Force.

A Yes.

Q And dealing with your education, sir, you attended the University of Alberta where you obtained a B.Sc. in Chemical Engineering in 1949.

A Yes.

Q And you began your working career -- I shouldn't say that, students will be upset -- you began your career with the Chemical & Geological Laboratories in Edmonton, after which you joined the Alberta Energy Resources Conservation Board as a gas engineer. Is that right?

A That's correct.

Q And you remained in that capacity until 1952.

A Right.

Q From 1952 to 1957 you were with DeGolyer and MacNaughton, who are well-known petroleum consulting engineers in Dallas, Texas.

A That's correct.

Q And in 1957 you joined Trans-Canada Pipelines Limited as chief gas supply engineer.

A Yes sir.

Q You were appointed vice-president of gas supply of that company in 1961.

A Yes.

Q You were appointed group vice-president responsible for gas sales, gas supply, and planning departments of Trans-Canada Pipelines in 1966.

A That's right.

Q And you became president of Trans-Canada Pipelines in 1968, is that correct?

A Correct.

Q And you remained in that position until you joined this project in 1972.

A That is correct.

Q And perhaps I neglected, Mr. Commissioner, to file what we have usually done with each witness, is to file his qualifications. Perhaps that could be given the next exhibit number.

(MR. HORTE'S QUALIFICATIONS MARKED EXHIBIT 127)

Your professional and business affiliations are shown in that exhibit, Mr. Horte.

A They are.

Q You're a professional engineer, you're a director of the Canadian Gas Association, director of the National Trust Company, and a member of the American Gas Association, etc.

A Yes.

Q May I ask you then, Mr. Horte, to go to the summary of your testimony in chief

and to give us the history of the development of the Arctic Gas project, and your association with it, and perhaps before you go on, Mr. Commissioner, this will be, I'm sure, ancient history to a number of people associated with the project, but I thought it would be useful at some time in these hearings to have that on the record. Mr. Horte will deal not only with that but with the internal organization and decision-making process in the company. Will you proceed, please, sir?

A Very well.

Mr. Chairman, my first association with this project goes back to 1967 during my employment with Trans-Canada Pipelines, when Trans-Canada, Michigan Wisconsin Pipe Line Company, and Natural Gas Pipe Line Company of American first commenced studies to determine the feasibility of constructing a pipeline into the sou thern part of the Northwest Territories, namely the Beaver River-Pointed Mountain area, where it was considered the potential existed for major discoveries of natural gas.

During the course of these studies it became apparent that the potential in this area appeared unlikely to be large enough to support such a pipeline. With the discovery of the Prudhoe Bay field in Alaska in 1969, however, it was decided to extend the initial studies by investigating the feasibility of a pipeline to connect with this area. Subsequently, in 1970 the three major producers in

Prudhoe Bay, namely, Exxon, SOHIO and ARCO, joined in these studies and these six companies then formed what was known as the Northwest Project Study Group. This group had a common interest in assessing the feasibility of transporting gas from Prudhoe Bay and the Mackenzie Delta, where exploration was then taking place, to U.S. and Canadian markets.

About the same time as the formation of the Northwest Project Study Group, another study group known as the Gas Arctic Systems, was formed with similar objectives and both groups then carried on their independent studies until June, 1972. At that time the two groups joined forces to form what then became known as the Gas Arctic-Northwest Project Study Group. The number of participant companies in the two independent study groups totalled 12, and upon their joining forces, additional participant companies were added to the new study group. The study group was set up on a basis whereby any company with an interest in the project would have the right to become a member simply by paying its share of the costs incurred by the study group. All studies made by the independent study groups at the time of their joining together were pooled and the costs for work done independently were picked up by the new group on a basis whereby each participant paid an equal share.

With the formation of the Gas Arctic/Northwest Project Study Group the participant companies decided to employ a full time management and staff to control and supervise numerous studies required to determine the viability of the project. The staff was also charged with the responsibility of preparing the necessary data required for filings before the appropriate regulatory authorities if as a result of these further studies it proves sound to do so.

In September of 1972 Mr. Wilder and I were employed as Chairman and Vice Chairman respectively of the study group, and as Chairman and President of Canadian Arctic GAs Study Limited which was formed to carry out this task in Canada for the Gas Arctic/Northwest Project Study Group. We subsequently have been responsible for hiring the other members of the management team and the staffing of the organization. An Alaskan Arctic Gas Study Company was also formed and Messrs. Ward and Mathews hired as President and Executive Vice President respectively of that company. They along with a small staff managed the operations of this company in Alaska.

Mr. Wilder is also Chairman of the Alaska Arctic/Gas Study Company. Mr. Brackett and myself are Vice-Chairmen of this company, thereby providing continuity and consistency in the overall approach to the project in Alaska and Canada. The studies undertaken in Canada and Alaska have mainly been done and performed by the same consultants so as

to provide a common and consistent approach, with special consultants being utilized in Alaska and in Canada to handle and deal with particular aspects and problems unique to each area. Canadian Arctic Gas Study Limited with its sister company, Alaska Arctic Gas, referred to jointly as Arctic Gas, have been responsible for the studies prepared on behalf of the study group and for the preparation of the applications submitted to the Department of Indian and Northern Affairs which is now before this Inquiry and for applications filed with the National Energy Board and in the United States, the Federal Power Commission and the Department of the Interior.

Now, those applications themselves are filed by -- in the name of the pipeline companies in each respective jurisdiction, namely Canadian Arctic Gas Pipeline Limited in Canada and Alaska Arctic Gas Pipeline Company in the State of Alaska -- or in the United States.

In carrying out its function, Arctic Gas has through its own staff and through the use of numerous consultants, worked under our supervision--and through the use of numerous consultants working under our supervision, prepared this material. We have operated with a relatively small staff with most of the detailed work being assigned to numerous consultants working under our supervision. The Management of Arctic Gas is responsible to the participant companies who have set up a management committee which operates in a manner very similar to

a Board of Directors. Each participant company is represented by a member on this management committee. The Management Committee meets monthly either in total or through an executive committee appointed by the Management Committee to review the progress of the project.

The broad policy of Arctic Gas is decided by the Management Committee. Within the policy guidelines the company management operates. The Management Committee is organized into three groups. One is Canadian non-producing companies, that is the Canadian transmission and distribution companies and Canadian companies that simply have a financial interest.

The second group we call the U.S. non-producing companies. It consists of U.S. transmission and distribution companies. Finally, there is the producer group. This consists of the Alaskan and Canadian producers. This grouping is reflected in the arrangements for voting. The agreement to which all members of the Consortium are party provides that no decision may be made without a two-thirds majority vote from each group. This ensures that no one group dominates the Management Committee.

The Canadian non-producers group consists of:

TransCanada Pipelines Limited
Alberta Natural Gas Company Ltd.
Canada Development Corporation
Consumers Gas

Union Gas
Northern and Central Gas Corporation Limited.

The U.S. non-producers group consists of:
Northern Natural Gas
Michigan Wisconsin
Natural Gas Pipeline
Texas Eastern Transmission
Panhandle Eastern Pipe Line
Pacific Lighting Gas Development Company
The Columbia Gas Transmission Corporation.

The producers' group consists of:
Imperial Oil
Gulf Canada
Shell Canada
Canadian Superior
Atalntic Richfield Company

The agreement provides that the participants may go and others may join and this has happened. Companies that have withdrawn are:
Transcontinental Gas Pipe Line Corporation
Canadian National Railways
The Alberta Gas Trunk Line Company
The Standard Oil Company (Ohio)
Colorado Interstate Gas Company
Pembina Pipe Line Limited.
Exxon Company U.S.
Canadian Pacific
Canadian Utilities

Numac Oil and Gas Limited/Sunoco E & P Limited.

Now, the members of the consortium have an influence in the decision making process of the Study Group in another way beyond just the direct influence through the management committee. YOu will appreciate that there is a very considerable body of experience represented by the companies that I have mentioned. We have formed Committees that have enabled our consultants and advisors to obtain the benefits of that advice, which represents an important cross-section of the natural gas industry of North America. Technical, Environmental, Financial, Legal and Public Affairs Committees have been designated by the Management Committee for the purpose I have just outlined. These committees often appoint sub-committees to review areas in which they have particular expertise. This organization I have described will of course be superceded by the usual type of organization where control is exercised through a board of directors when construction commences. When the project is financed.

I would like now, just to briefly the organization chart for our present organization and we have a view graph here which would be helpful.

This is the present organization chart for Canadian Arctic Gas Study Limited and represents the organization as we see it. Now, in these broader terms that will be the organization utilized during the construction phase of the project.

Starting at the top of course the Chairman and Chief Executive officer below which the President and reporting to the president the -- those shown on the first line in their very functional areas. Vice-President of Finance, Operations, Engineering and Construction, General Manager of Employee and Public Relations and our Vice-President and General Counsel.

Now, I don't intend to go through all of the positions shown on this organization chart, but I think in particular it would be helpful to review with you in a bit of detail the positions under the two headings Vice-President of operations and Vice-President of Engineering and Construction as those are very key in terms of the subjects being discussed before this Inquiry.

I will just mention starting on the left hand side under the Vice President of Finance, however, I think most of the titles shown there are self-explanatory as to why they would report to the Vice-President of Finance, down the second column, the second block from the bottom you will see the Manager of Administration for the Calgary Office. This is simply because of convenience that the administrator in the Calgary office reports to the controller in the Calgary office.

One other point and just to the right of that on the bottom block you will see Economic Advisor, and if you follow the line up you will see that the Economic Advisor reports to the

Treasurer. It was just shown this way to make room on the chart. The Economic Advisor also happens to be the same person who has in our studies had a great deal to do with the economic impact of the project in the Northwest Territories and also on the overall Canadian economy as well as being very much involved in the socio-economic considerations in the Territories.

Going to the next,functions under the Vice-President of Operations, the first block, I think is self-explanatory, this is simply the director of operations and maintenance who will be the man of direct line and responsibility for operations and maintenance.

The next column, the Director of Environmental Protection and Community Relations. I would like to mention that while this position is shown as reporting to the Vice - President of Operations, during this phase in our planning he has reported in a dual role and probably to a greater extent has liason and worked with the engineering and construction people with the environmental inputs. He reports in the direction shown fundamentally because this is an ongoing position as we see it where in addition to the environmental input to the actual engineering and construction, there will be a continuing role during the operations and over the life of the project in this area.

The community relations also handled by this director are handled in that manner fundamentally because No. 1, the person involved and his own, if you like interest or feel for this area, plus the fact that we feel that the environmental and the sociological considerations are very much related, and that by these two functions really reporting to this one man, we feel that that will provide better co-ordination . As you can see below that, this man will have a manager for Northern Affairs, or on the socio-logical aspects of things reported to him. He will have a manager of environmental protection, and the last block shown is a manager of northern business planning. This is a position that, as we see the project developing, more and more emphasis will -- it is an area where more and more emphasis will be required in that this will be our man charged with liaisoning with the communities, the various levels of government to develop plans to make sure that there is participation in the north, and that oppor-tunities are made available not only in the employment area but in the actual business community in the north and the development of that business community.

Going to the next main head-ing on the chart, the vice-president of engineering and construction, and reporting to him the director of labor relations, and I think I might take a moment there, to explain that the director of labor relations is shown reporting here rather than to the manager of

employee relations simply because this man will be dealing more directly with those labor relations associated with the large pool of labor that will in fact be employed by the contractors to a great extent on the project. The union problems and other problems that are associated with that, so his -- this will be his main function. Obviously this will be co-ordinated very closely with our overall employee-relations policies, but is somewhat different than the longer term employee-relations problem in that it's particularly geared to this construction phase and the large number of people who will be involved with the contractors.

The next heading, I think, is self-explanatory, is the director of procurement, and really he'll be director of procurement and logistics, the man responsible within the company for negotiating the terms of our material supplies, etc., and assuring us that in fact these supplies will be available when required, in the most expeditious and the lowest cost method possible.

The manager of budgeting and planning, shown immediately below that, is not an overall corporate manager of budgeting and planning, but simply the budgeting and planning associated with construction itself.

The next man or the next position, really, I don't believe requires explanation. This is the director of construction, the man who will be directly responsible for the construction aspects.

Immediately below that is director of engineering, who will be directly responsible for the engineering design aspects of the project.

Below the director of engineering you can see is assistant director of engineering, technical services, assistant director of engineering facilities, and below them many other managers assisting the director of engineering, and off to the right on the two blocks shown, similar assistants to the director of construction, and many, many other managers which will be required below them.

With respect to the -- those positions reporting to the general manager of employee and public relations, I really think those are quite straightforward and I only make the comment again that as a matter of convenience, the manager of administration, shown in the lower block, for the Toronto Office, reports to this manager.

On the far right, those positions reporting to the vice-president and General Council, I think, are all self-explanatory. Unless there are any questions at this time -- but I guess we'll deal with those later.

MR. GENEST: Sir, I have a printed copy of that. You might like it filed as an exhibit.

THE COMMISSIONER: Yes, please.

(PERSONNEL STRUCTURE MARKED EXHIBIT 128)

MR. GENEST: Perhaps, Mr. Horte --

THE COMMISSIONER: Excuse me, Mr. Genest. Miss Hutchinson, you might have copies made and distributed.

MR. GENEST: Sir, I have some but we've just mislaid them, and I'll find them within the next half-hour.

Q I'm going to move on now, sir, to sort of miscellaneous subjects because they arose during the course of the hearings, and the first one I want to deal with is the question of pipeline sizing, and the process by which you arrived at a decision, Mr. Horte, to propose the use of a 48-inch pipeline at the pressures about which we've been hearing. Could you deal with that, please?

A Yes sir.

In determining the size of the pipeline, it became apparent at the outset, when one considers the distance over which the gas would have to be moved, that a very efficient system would have to be designed and constructed if the project was to be economically viable. Generally, providing gas volumes are available to justify its sizing, the larger the diameter of a pipeline the more efficient or more economical the transportation of gas through such a pipeline becomes. This, of course, is also a function of the pressure at which the pipeline will be operating ,but given common pressures the larger you can go on diameter, providing you have gas volumes to justify it, the more economical the facility. With this as a basic criterion, and the further criterion

V.L. Horte
In Chief

of the line being designed, so that it was capable of being constructed with existing technology, we arrived at a conclusion that a 48-inch diameter high pressure system operating at 1,680 pounds was the most efficient system. Our studies showed that such a pipeline operating at fully powered capacity would be capable of movi ng 4.5 billion cubic feet of gas per day.

Obviously, such a system would not be viable if the volumes of gas available from the Alaska North Slope and Mackenzie Delta were not sufficiently large. Our review of the situation indicated that volumes of 2 to 2 1/4 billion cubic feet per day or larger would be available from the then discovered Prudhoe Bay area in Alaska where reserves are estimated at about 24 trillion cubic feet, and that the future potential of this area was also large.

It was judged that one could reasonably count in the near term on volumes of gas from the delta on the Canadian side of one to 1 1/4 billion cubic feet per day, and again that additional volumes were likely to be developed thereafter.

Assuming the demand exists, the key to the feasibility of any project, of course, is not necessarily the ultimate volumes that may be available in an area, but the initial volumes which are demonstrated to be proven and available to support the initial financing of the project if in fact no other reserves were discovered. In this connection our studies indicated that feasibility would be assured with the initial volumes from both sources indicated of three to 3 1/4 billion cubic feet per day. We expect, having regard to the high potential of both areas, that the project starting at that level of throughput would in a few years be operating at its full capacity of 4 1/2 billion cubic feet per day.

Now in connection with the sizing of the pipeline, a question has often arisen in connection with the sizing of the northern laterals themselves, whereby they are, as you know, both sized at a 48-inch diameter as well as the 48-inch diameter for the main line. So that if you have two of these 48-inch diameter pipelines coming together ultimately the capacity of the two lines would be up to nine billion cubic feet per day. Now two major considerations went into this decision. These were the impact on the environment and the economic feasibility of the project. The potential of the North Slope and the delta made it seem quite realistic to look forward in the long run to a throughput of 4.5 B.C.F. per day from each of the producing areas. This alone justified building in future capacity, but perhaps not

to a 48-inch size on the basis of economics alone. But there was the further consideration -- the environmental consideration. Over-sizing in this sensitive northern area would reduce the necessity for future work associated with expansion in those areas. It seemed to us that the combination of these factors justified over-sizing these supply laterals particularly since the overall economics of the project as a whole would support this over-sizing.

Q Could I ask you to explain that a little, Mr. Horte? You say the economics of the project as a whole

A Well, when we look at the total cost of the project, including those two 48-inch laterals, and the cost of service associated with that, it is our estimation that the economics of transportation are such that gas will land on the market place on a truly competitive basis with any other form of energy now being looked at in the market place. The only other thing I could say, if you sized in the initial years those lines down to a lesser size, let's say 42-inch, it would improve the early year economics. Whether in the long run on a straight economic basis it would prove to have been the right decision or not, is something we'll only know after the fact because if the buildup of volumes were rapid, then one would find that the 48-inch diameter would certainly have been a wise decision on the basis of economics alone. Whereas if the buildup were slow, the economic decision would probably favor the 42-inch system; but

when we combine the two, having regard to the environmental aspects, the project could, in our opinion, on the total basis demonstrate economic feasibility, we chose this course.

Q Well, I interrupted you, Mr. Horte. You were, I think, going to expand on the environmental aspect, which is, as you say in your statement, to delay additional work or looping in the sensitive northern area.

A Well, to the extent that you have additional capacity available in the initial system, it certainly means that as additional reserves are developed, less looping will be required by that over-sizing.

These, then, are the reasons for the selection shown in the original filing. Subsequently, as you know, we have also filed, as I've mentioned, an alternative proposal showing these two laterals sized down to 42-inch diameter systems operating at the same high pressure. This was done so that a comparison could be made of the costs, and the effects therefore of smaller size laterals. While there are some immediate financial savings, as I have mentioned to the 42-inch line, we prefer at this time the 48-inch laterals. If the rate of discovery in the delta proved disappointing, or if costs escalated beyond our present expectations, which might change that overall economic consideration, then it could be desirable to opt for 42-inch laterals. For these reasons we felt that alternative should be considered by the regulatory

authorities and this Inquiry in the first instance.

Q When is the decision, Mr. Horte, relating to the size of the laterals, likely to be made, in your present judgment?

A Well, certainly once the approvals are obtained and we have the benefit at that time of a further evaluation of the economics, once we have firm bids on various parts of the project and aspects of the project, we have an additional assessment as to the reserve situation, what's happened in the meantime, then would be the time. Obviously you have to make it before you order your pipe and equipment can proceed to get on the ground.

So it would be shortly after the regulatory approval.

THE COMMISSIONER: You've said, Mr. Horte, that sizing depends on a number of things, but one of them was the extent of the reserves. You gave us at the bottom of page 7, a figure for the reserves, Prudhoe Bay, 24 trillion cubic feet. You didn't give us a figure as regards the delta reserves. Can you give us a figure that would cover that?

A Yes, our estimate of the delta reserves which we filed with the National Energy Board, with the Federal Power Commission, in those proceedings, and I'm not certain whether those exhibits --

MR. GENEST: Well, we've had our little arguments about that, Mr. Horte.

A -- filed, and those

Mackenzie Valley i 6.5 t

cubic feet at the present time. That is made up of reserves categorized as proved, probably or possible. It's our estimate that the reserves that will be developed in the fields now discovered, having regard to the seismic of the area, etc., it does not include simply because of the time at which the work was done, this winter's drilling, and some new wells that have been drilled this winter.

THE COMMISSIONER: Mr. Horte, the sizing, the extent of the reserves will have a bearing on sizing and looping and the life of the pipeline itself, and you've given us the figure of 6 1/2 trillion. I think I read in the paper that the president of Alaskan Arctic, your sister company, gave a figure just very recently, I wish I had the figure before me, and if the matter is one that doesn't spring to your mind, I'll try to find it but it seemed to me to be a much higher figure. You must have been giving a speech somewhere. Are you aware of the --

A I wouldn't think that with respect to those reserves --

Q He was speaking about Mackenzie Delta.

A I suspect he was probably talking about the estimated potential for that area, if he gave a much higher figure, and in that regard in these same exhibits our consultants estimate that the ultimate reserves that may be developed, in other words the potential that they foresee in the Mackenzie Delta, they foresee it to be well in excess of 50

trillion cubic feet, that is for the on-shore and off-shore Beaufort Sea area combined. There are similar figures on the North Slope of Alaska or the estimates exceed 100 trillion cubic feet, estimates have been made by the Geological Survey in Canada where their estimates, as I recall, are in the order of 90 to 100 trillion cubic feet in the Mackenzie Delta and Beaufort Sea areas. So that gives you the order of magnitude of how people estimate the potential of the area to be. I would expect it's a figure such as that, that he must have been mentioning. He certainly is aware of these numbers, they are in his own application.

Q In your application to the Minister in March last year, that is to the Minister of Indian Affairs & Northern Development, did you give a figure for the reserves, proven reserves in the delta?

A They were filed, sir, not at that time, but they were filed as I recall about October or November of 1974. The additional information was filed.

Q No, I don't mean the filings, I mean the actual application. I think a figure of -- well, it can be checked and I don't want to detain you in giving your evidence in chief, but I think it was a figure of about -- well, we'll have to look it up.

A I'm not certain, sir. We could certainly check that.

MR. GENEST: I'll have that for you in the morning, sir.

THE COMMISSIONER: Well, I'm sure it's on this desk somewhere. Well, carry on, sir.

MR. GENEST: Well, sir, if I might be permitted to just follow up on some of your questions. Perhaps it might be useful, certainly it was useful to me to learn about the distinction between proven reserves and probable reserves and estimated reserves.

Q Could you tell us how these are arrived at? They are arrived at on some scientific basis, I understand.

A When you catagorize between proved, probably and possible, I guess to some degree it is a judgment factor just where you draw the line between proved, probable and possible in a discovered field. -- And I will deal with that separately. If you go beyond that, when you are dealing -- when you are talking about proved, probable and possible, you are talking about reserves, in a normal sense of the word, that you believe are associated with an existing discovery and that is a field or a structure now discovered and known to contain oil or gas.

When you talk about potential reserves or ultimate reserves in an area you are usually talking about somebody's evaluation of what people are likely to discover when they drill new structures that have not been explored, the drill has not penetrated these structures and these evaluations are made by looking at the overall geology of the area, the amount of sediments that are likely to be in the area. The similarity of those sediments to other known areas in the world where hydrocarbons have been discovered and the evaluation of the structures in the area, the likely accumulations and through this and a great deal of judgement, people estimate what they think the ultimate potential will be and certainly they are not always right, because that is a very inexact science as compared to estimating the reserves within a field that has been discovered where you actually have some data and you know that a hydrocarbon exists.

Now, in a field where an estimate of the reserves in that field, certainly in the early stages -- let's say that the field has one well in it, he'd be inclined because of lack of additional wells in the structure to estimate the proven reserves based on one well as rather small. HOwever, if he had seismic information which confirmed the existing well and it showed the outline of the structure from seismic that he had confidence in, he would probably extend himself to saying that well, I feel more -- I feel less confident, but still quite confident that probable reserves will extend out to this point in that structure and the possible reserve category is a category where he says, well, I still think there are great possibilities in this structure because of structural outline. They are less certain than the probable category.

Historically, I think this type of evaluation has in general terms demonstrated that with the additional drilling, while they may not outline the particular structure absolutely correctly, that generally the ~~element~~ ultimate reserves developed in the field follow very closely, not any particular field, but a group of fields to be reserves that really equal the total proved, probable, possible, even though you can't categorize them all as proven at a particular point in time. That is about as far as I can go on that.

MR. GENEST: Thank you. Could I go then, Mr. Horte, to the subject of pipeline

looping and perhaps we could discuss looping as you have done in your prepared testimony in general terms, what is exactly is involved and then relate it to this Mackenzie Valley Pipeline.

A Yes, sir, well, essentially, looping is a flexible means of increasing the capacity of a pipeline. It means adding capacity by laying an additional segment of pipeline downstream of each compressor station and tying this segment back into the existing pipeline. The length of loop segment is determined by the amount that;you wish to increase the total throughput. Eventually, as you continue to increase the capacity of the pipeline by adding additional segments of loop you will end up with a duplication of the existing facilities. But this is done over a period of years and only as demand and supply demonstrate the feasibility and desirability of increasing the capacity of the system.

I would now like to show a chart which demonstrates this capacity looping relationship.

MR. GENEST: I have copies of this, sir, for everybody. It might be given the next exhibit number.

(CHART ENTITLED "EFFECT OF LOOPING AND INCREASING HORSEPOWER ON GAS DELIVERIES" MARKED EXHIBIT 129)

A Well, what this chart depicts is the amount of increased capacity that one gains with various amounts of looping. Across the bottom

of the chart is shown the percentage that would be looped out, that is, the per cent between compressor stations at any point in time and along the left-hand side of the chart the corresponding percentage increase in deliveries that this would result in.

For example --

MR. GENEST: let me just stop and make sure we all understand this. The bottom line shows the percentage of additional pipe that you add.

A Yes, sir.

Q 100% being a whole new pipeline.

A Whole new pipeline, right,

Q And then below that a segment of pipe that ties back into the main pipe?

A Yes, sir, yes.

Q And the vertical column shows what you get by going through that process.

A In terms of increased throughput.

Q And you have got two curves. One is keeping the same com -- the first is with the existing compressor stations, is that right?

A That is correct.

Q And the next is by adding compression.

A yes.

Q I am sorry, would you proceed.

Q Well, for example, and let's

use the lower, the lower chart which is really, the lower curve which is really the situation that one is in, when one commences to loop a system, This depicts our 48" system, proposed 48" system and shows that that system initially that line shows that it is powered up with 30,000 Horsepower stations all the way along the system. It is fully powered and now we commence to loop the project and just living with that amount of Horsepower on the system --

MR. GENEST: By fully powered, Mr. -- I am sorry to keep interrupting -- by fully powered you mean that all the compressor stations that are planned or that the line will economically handle have been installed, you are running at maximum capacity.

A It would be operating at, say, 4-1/2 billion cubic foot a day throughput. And it is not economic to add additional horsepower, you really now have to start the looping process.

So, looking first at the bottom of the chart and looking at -- no -- let's start on the left-hand side of the chart. Let's assume that one wanted to increase the capacity of the system by 10%. In other words, the reserves were available to justify this and that markets were available for that additional quantity of gas. If you move across from that 10% until one hits the curve, you would see that you would have to loop about 30% of the system, 30% downstream to each compressor station in order to gain an increase in capacity of approximately 10%.

As you go up the curve, let's look at the next 10% increment. If you went now to increase the capacity by an additional 10% you would find at that point that the amount of looping required was 55%, so you can see in this second segment that we talked about the amount of loop as compared to the first is only 25% more as compared to 30% for the first loop to obtain the same 10% increase in throughput.

You go to the next percentage increase it is a 30% increase, you can see that a total of something over 70% of the system would have to be looped, now only a 15% or between 15 and 20% increment on looping to gain this same 10% increase in capacity and so on as you go up the curve, where near the latter stages of looping the percentage increase in capacity gain is much greater than in the earlier stages of looping.

Ultimately, this chart shows that with only the initial horsepower on the system and when that system were fully looped out it would have an increase in its capacity of about 55%.

Following this, having looped the system out, one would then, either then or possibly earlier, depending on the particular economic situation that would have to be looked at at the time, let's assume you looped out first, which I think is the likely case, you would then commence to add additional horsepower. You would then commence to duplicate the horsepower of the existing system and the effect of that would be, when fully powered up again in duplicate, to increase the capacity from 55% to 100%, or a 45% gain on the original capacity of the system; and this again can be done incrementally. In other words, you can proceed with the horsepower increment, similarly to what you did with the looping increment.

Q Mr. Horte, when you say "we're adding the horsepower", does this mean building new compressor stations, or is that done at the existing compressor stations?

A It's done on exactly the same site.

Q On the same site?

A Right.

Q You just add another compressor.

A Yes sir, and of course in the case of this system you would have to add additional chilling facilities to accompany that additional compression.

Q But we're talking now

about at the same sites.

A At the same sites, yes.

Now, of course if the demand for the gas were not there you would have no reason to expand your facility, and looping would not take place. In discussing this subject more fully, I'm going to assume that there is a growing demand for both delta and Alaskan gas, and I will consider the constraints imposed by supply.

Now pipelines are normally financed, at least long-distance transmission lines, on the basis of 20 to 25-year contracts for the sale of the gas and supply contracts to reasonably assure these sales over the same period of time. In other words, to finance the facility, one must have back to back contracts, you have the supply to increase the load over that term, you also have to have sales contracts for the sale of it over that same period.

Q But the gas has to be there with a willing seller.

A A willing buyer.

Q And there's got to be a willing buyer at the other end of the pipe.

A Yes.

Q Right./A: Now that does not mean that even initially that you must demonstrate full deliverability for the whole 20 or 25 years. This is simply not possible in terms of the economics of producing fields. In good conventional fields field deliveries while you contracted on -- let me go

back for a second -- a 20-year contract in a field would be based upon an estimate of the reserves in that field and the reserves in that field being divided by 20 years, so that the annual contract quantity would be 1/20th of the total reserves known or shown to be available from a particular field. Now that doesn't give you the assurance of reserves that they will be deliverable over that 20-year period. In good conventional fields, deliveries will be maintained at a constant level for approximately 12 to 16 years, or roughly 2/3rds of the life of the reserves. Thereafter the deliverability from the field commences to decline, and the field will continue to produce over a further period of 10 to 15 years, in most cases.

Q Why does it decline, Mr. Horte? The pressures aren't there any more?

A We are reducing the pressure of the reservoir as you produce the gas from the field, you might consider it like a balloon. When you've pricked a balloon the air comes out very quickly to begin with, and as you deplete the pressure it comes out less quickly.

During the period of constant deliveries, pressures in the field decline and result in lower deliverability from an individual well, for the reason I've just stated. But this decline is offset by an infill drilling, in other words you punch more holes into the balloon, so that while the amount coming out of any one hole is being reduced, the more holes you have you would be able to maintain that level of

delivery from the field as a whole. But there comes a point where it is not economic to drill more wells simply for the purpose of maintaining deliverability. And hence the period of decline. So that while reserves are normally sufficient to look after the supply for a 20 or 25-year period, over which they are contracted for, the physical ability in all cases is somewhat less in terms of producing those reserves at a constant rate. This factor is recognized in the original financing of a project and is taken into account by assessing the potential of the area and the likelihood, therefore, of this relatively minor lack of deliverability in later years being filled in by future reserves to be discovered.

I would like to make the point that any looping program is only undertaken when additional reserves have been developed and supply contracts entered into which will support the life of any new facility in a manner similar to which the original reserves dedicated to the pipeline were capable of supporting the original facility. In other words, you don't increase the capacity of the system unless you have an increase in reserves to support it. You don't simply produce the existing reserves at a faster rate thereby lessening the life of the facility. Over a period of years, as additional reserves in the area are developed, and when a decline in deliverability commences in the reserves initially dedicated to the project, new additional reserves will have to be utilized to fill this decline in deliverability.

Q That decline in deliverability from the original facilities?

A Yes sir. Thereby leaving a lesser amount of any new reserves developed in the area for expansion or looping of the existing facility. The choice of whether to expand at a particular moment in time versus utilizing reserves to maintain deliverability is a question that must be assessed in light of the then rate of discovery of new reserves in the area and the potential that still exists for finding further reserves.

You should appreciate that in the case of any facility expansion these factors not only are considered by the company involved in the expansion itself, but their plans and certification for any new facilities must be approved by the regulatory body to which they are responsible for any such expansion. The effect of what I am saying is that looping should not detract from the ability of the pipeline to meet its long-term contractual commitments.

Q Can I ask you here, Mr. Horte, again as to whether looping also will shorten the life of an existing facility?

A It will not shorten the life over which that facility was financed, etc., and the contracts upon which it was based, and therefore the service it was intended to perform. You would have to say this, that if everything else took place, that the life of -- if you never looped the facility and somebody were still interested in going out and

developing new reserves, but waiting 20 years before they could bring them to market, then in that case if you never expanded it and you could still get those reserves, and encourage their development, that the life of the facility would be longer, if you didn't in fact loop it.

THE COMMISSIONER: And the cost of the pipeline, having been amortized fully, the gas would be much cheaper, I guess.

A Yes, that's true.

MR. GENEST: Now, would you go on, Mr. Horte, with the question of the proposed looping of the proposed pipeline?

A Well, with respect to the looping of the pipeline we propose, as you know our estimate of future reserves development would indicate that this pipeline might be fully loaded to the 4 1/2 billion cubic foot level by its fifth year of operation, and therefore any looping would not take place until after the original capacity of the system was fully utilized, and then only if additional developments in the area for the reasons I have outlined justified such looping. I should add, however, that one -- that when one looks at the potential of the Mackenzie Delta, Beaufort area, and the Prudhoe Bay area, as we see it now, I think it is most likely that this pipeline over a period of time will be fully looped.

MR GENEST: Q Could you give us Mr. Horte -- I realize that this depends on a very large number of presently unknown factors, but can you give us your best present estimate of the range-- what you see as the range of timining and the amount of looping that might take place.

A Well, I would sure agree with you that it is a very difficult thing to estimate, because there are so many unknowns and variables in it. But if you were to look back at this chart shown on the screen, a fully looped out system would require a volume of gas reserves and a market that would support a 55% increase in the original throughput of the system.

If you are talking about a 48" system, 55% of that 4 1/2 billion cubic feet a day the original capacity, would be in the order of 2 and 1/2 -- 2 1/4 to 2 1/2 billion cubic feet of gas a day, that you would have to see reserves supporting over the life of that additional facility.

Now, when you look at the amount of reserves that would be required to support that level of throughput, you are probably talking in the order of 18 trillion cubic feet of additional reserves required to support that.

I think it also likely,as indicated by this chart and considering the area one is in, that loops are ikely to be added in increments where you would do a full seasons work in the area while you were there.

This meaning that you would probably loop this thing out in three increments. And you can see from looking at that chart, that if you did that in equal increments, the first increments where you looped about 30% or slightly in excess would give you an increase in capacity of about 10%. The next increment would increase that to just over 20%, 25% in that area, and the final increment would get you up to the 55%.

Now, this would require as I mentioned in the reserves development within the period of time in which you did this of somethingin the order of 18 trillion cubic feet. So then one has to look at the question of what is the likely time period over which reserves of that magnitude might be developed in the Mackenzie Delta and on the North Slope of Alaska, if you are combining the two volumes.

I don't think it is unreasonable having regard to the potential of those two areas, particularily when a pipeline facility is in the area, to assume the possiblity that those reserves could be developed over a three or four year period, and that therefore this looping could take place over a period of time of three or four years.

THE COMMISSIONER: Beginning in three or four years?

A No, this would be after you had fully loaded the existing facility, and it would once the system were fully powered up.

MR. GENEST: That's five years.

period, in which you would wait for the increments. Maybe the increments would only be developed every three years. It's strictly a function of that rate of development and of course, depending on that rate of development your assessment as to whether or not looping in fact is justified in the first instance.

I think you would want to be fairly confident when you started a looping program that you could expect over a period of time to complete that looping, even though you weren't assured of it. You would want to be fairly confident that that would be the case.

Q Well, your first year of making -- of delivering gas under the existing proposal is one year before construction actually is completed, as I recall. Because you will deliver the Delta gas while you are still building the Prudhoe Bay supply line, so that there might be--

A There would five years-- five operating years, including that as the first year before you-- based on present prognostications of when you might have it fully powered. Of course again there is an unknown with respect to that fully powered system, and the reserves, the volumes are not there today which could assure you of fully powering that system.

Q Yes. The -- but what you are saying is that we are looking at three years of pipe laying, then construction will cease for four years, and then we might be -- might be looking at three years of pipe laying again after that.

A Yes.

Q I just want to make sure I understand --

A Yes sir, and between the periods of pipe laying the addition of horsepower takes place in those intervening years.

Q Yes.

MR. GENEST: We've just got a little way to go on looping sir, and then should we finish the subject and then break?

THE COMMISSIONER: Yes.

MR. GENEST: Would that be satisfactory?

THE COMMISSIONER: Yes, certainly.

MR. GENEST: Q Would you go on Mr. Horte. You were going to talk about impact now.

A Well, the looping of the pipeline, if and when it occurs, will, of course, involve environmental impact similar to the environmental impact of the original line. It will obviously be smaller in scale as it is unlikely you would completely loop the line in as short a period of time as you constructed the original system.

It would be built up in increments over a longer period. We would expect the impact to be somewhat less than in the original line in that logistical facilities will have previously be constructed, the same right-of-way would be utilized,

albeit that this might have to be extended for a distance of 15 to 20 feet and, of course, any compression added in connection with the loop line would be located on the original compressor station pads. Very few, if any, additional operational impacts would occur. I think it is also obvious that further impacts on an area already impacted upon will be of less environmental and sociological significance.

MR. GENEST: That takes us sir to another subject. Would it be convenient to adjourn now.

THE COMMISSIONER: Yes, I think that even though you and Mr. Horte are fresh, the rest of us have been slugging it out here since nine in the morning.

One thing that I just want to leave with counsel. I'm not asking anyone to respond now. What Mr. Horte has said indicates that we have before us a proposal for a-- for the construction of a gas pipeline and the three peak periods of construction are the three winters.

They were discussed Mr. Horte, by Mr. Dau and his colleagues, I think it was last week. Counsel might consider whether it would be feasible, since if now appears that after a four year hiatus, there would be a second construction project lasting three years. Counsel might consider whether it would be feasible to for evidence to be called at an appropriate stage to determine how many construction workers would be involved on that project.

The logistical facilities who would all still be there presumably, the wharves and so forth, and the 400 flatcars that the C.N.R. has ordered.

But we would have, if looping did occur in the way that Mr. Horte has outlined, we would have another three year project, that in many ways that is as vast as the one that is before us.

Well, counsel just might think about that.

MR. GENEST: Well, sir, I have thought about that.

THE COMMISSIONER: Well --

MR. GENEST: And I have some preliminary observations that might be useful for counsel to mull over as well.

THE COMMISSIONER: Yes, Please tell us.

MR. GENEST: And that is this, that I think the evidence previous has indicated that additional right-of-way would be required. That an existing application to the Minister is to construct one pipeline, that a fresh application under the Territorial lands Act would have to be made to the Minister for any looping program that would occur.

In addition, a fresh application to the National Energy Board would have to be made, and as I understand public hearings, at least under the National Energy Board would be required to be held.

I should also advise you

sir, that we have not had any detailed studies of any kind with reference to the looping of a pipeline. We cannot bring forward the kind of evidence that you have heard in connection with this project, which would be related to a looping construction program.

The technology that would be involved depending on the time at which any such looping would occur might be entirely changed.

So my preliminary submission is that it might not be a very useful exercise. I think it is a factor for everyone to bear in mind when they are considering the presence of a pipeline here. It may have socio-economic consequences, some of the bad ones, some of the good ones. It means a continuing if you are looking at employment opportunities, it looks to a renewal of these.

But to try and call on Arctic Gas to produce evidence that would be of much use to the Inquiry as to the type of logisitical programs that we have, the construction workers that we have, it would be very difficult for us do so with any degree of reliability. And perhaps that is something, together with your comments could be considered by others.

THE COMMISSIONER: Yes. Well, thank you Mr. Genest. I've said that all counsel might consider what I had to say because I didn't mean to imply that the burden would be entirely thrust upon Arctic Gas if we were to seek such evidence. That is not to say though that it would not be thrust upon you if we were to seek such evidence.

But, you will remember Mr. Dau said that during those three peak years you would have in the second winter certainly -- you would have almost 10,000 construction workers, and supervisory personnel on those spreads.

And you would have many thousands of men on those spreads during the first and third winters as well. To put it in a fairly blunt way, if there is a likelihood of all of those construction workers or their counterparts, assuming they had come, many of them, from the south, returning in four years, that is something that I think we should bear in mind. It may be that all we need is the back of an envelope to get some rough idea of how many construction workers might be returning and really I just wanted all of you to give some thought to that and when you said, Mr. Horte, that this estimation of reserves was an inexact science, I just looked up Mr. Fielder's statement about Prudhoe Bay reserves, it was a statement that he made yesterday and he had them at 27 trillion -- 3 trillion more than you did, but I am sure --

MR. GENEST: What is a trillion or two --

THE COMMISSIONER: What is 3 trillion -- Well, we will adjourn until 9 o'clock tomorrow morning.

(PROCEEDINGS ADJOURNED TO MAY 22, 1975.)